



Università degli studi dell'Aquila

Clinica Oculistica

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**Indicazioni e Tecniche
della Cheratoplastica Perforante**

M. Ciancaglini

Review Article

Paradigm Shifts in Corneal Transplantation

Donald TH Tan,^{1,4}*FRCSED, FRCOphth, FAMS*, Arundhati Anshu,²*FRCSED*, Jodhbir S Mehta,^{2,4}*FRCSED*

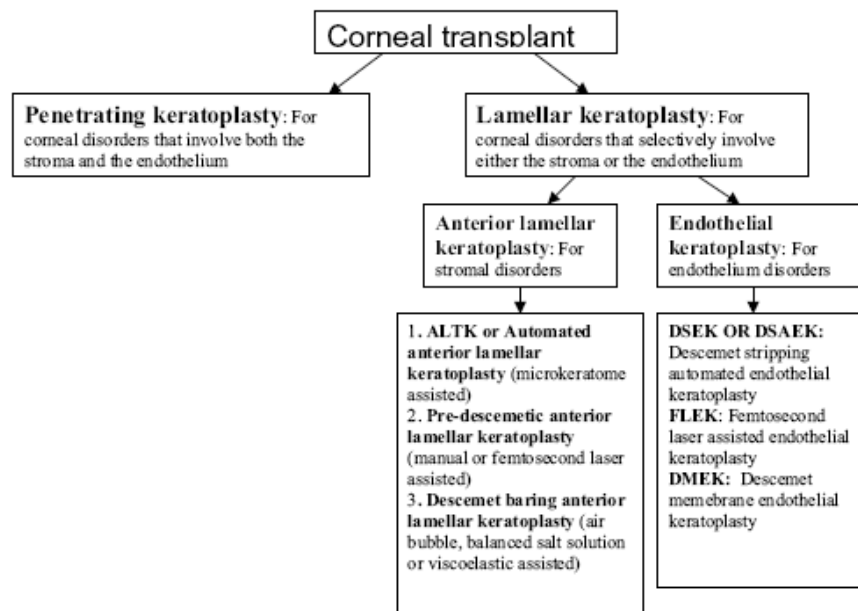


Fig. 1. Schematic diagram depicting the various forms of lamellar keratoplasty procedures and the indications.

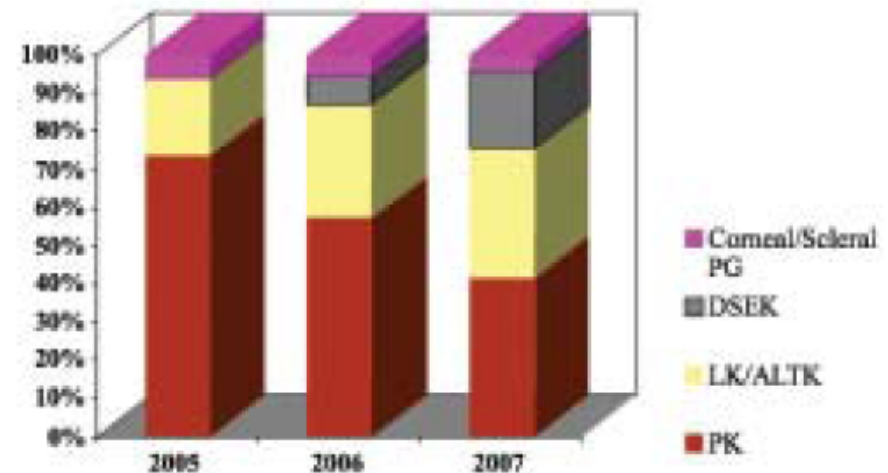


Fig. 2. Bar chart depicting shifting trends in corneal grafting procedures at SNEC over the past 3 years. In 2005, penetrating keratoplasty (PK) was the most commonly performed grafting procedure while in 2007, lamellar keratoplasty in the form of anterior lamellar keratoplasty (LK and ALTK) and descemet stripping endothelial keratoplasty (DSEK) was the most common procedure.

EDITORIALS

Deep Lamellar Keratoplasty

SHIGETO SHIMMURA, MD, AND KAZUO TSUBOTA, MD

DEEP LAMELLAR KERATOPLASTY (DLKP) IS A CHALLENGING yet rewarding choice of surgery for keratoplasty patients who have a healthy endothelial cell count.¹ Penetrating keratoplasty (PKP) in these patients is not only unnecessary, but places the graft at risk of endothelial rejection, which can occur in approximately 20% of cases.^{2,3} Keratoconus patients are perhaps those who benefit most from a successful DLKP procedure. Although the 5-year success rate of PKP in keratoconus is over 95% in most studies, an episode of endothelial rejection can be detrimental in these young patients who may require a second keratoplasty procedure with an inevitably worse prognosis.

Finally, there is also a need to establish the proper indications for DLKP. Keratoconus is certainly a good indication; however, cases with scarring of DM may affect visual outcome even if the procedure can be completed successfully. Hereditary dystrophies of the stroma are also candidates. However, we have experienced cases of macular dystrophy with continuous loss of endothelial cells after DLKP. Ocular surface diseases such as chemical and thermal burns are good indications once reconstruction of the epithelium is achieved, and residual opacification of the stroma requires treatment.¹¹ DLKP is especially effective in such patients with vascularized corneas, and who are thus at high risk of endothelial rejection. Corneal

Although several techniques for DLKP are reported in the literature, each surgeon should choose the method that feels most comfortable. Although the long-term results of DLKP are awaited for definitive conclusions to be reached, the available data to date show that DLKP can indeed be the ideal choice of surgery for patients with healthy endothelium.



**EYE BANK
ASSOCIATION
of AMERICA**

**2008 Eye Banking Statistics Reported by U.S. Banks:
Distribution of Tissues
77 U.S. Eye Banks Reporting**

Distribution	2008	2007	2006	2005	2004
Corneal Grafts Total	52,487	50,122	45,035	48,298	51,544
Penetrating Keratoplasty	32,524	34,806	38,064	45,821	51,544
Anterior (Lamellar) Keratoplasty	1,072	950	806	869	-
Endothelial Keratoplasty	17,468	14,159	6,027	1,429	-
Keratolimbal Allograft	173	207	138	179	-
Tectonic	1,250	-	-	-	-
Sclera	5,374	4,698	4,018	3,886	5,323
Long-Term Preserved Corneas	989	-	-	-	-
Research	13,730	13,824	11,845	14,332	15,780
Training	5,385	4,801	4,858	5,477	4,852

Indications for Penetrating Keratoplasty in North China

Lixin Xie, MD, Zhenhua Song, MD, Jing Zhao, MD, PhD, Weiyun Shi, MD, PhD, and Fuhua Wang, MD

(*Cornea* 2007;26:1070–1073)

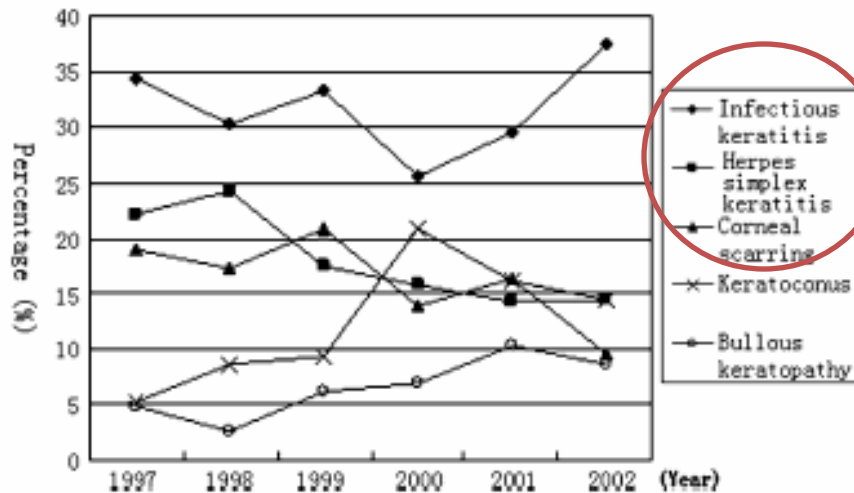


FIGURE 1. Trends in major indications for PKP from 1997 to 2002.

Infectious keratitis remains the most common indication for PKP in north China.

TABLE 1. Clinical Indications for PKP Between 1997 and 2002

Indication	1997 [n (%)]	1998 [n (%)]	1999 [n (%)]	2000 [n (%)]	2001 [n (%)]	2002 [n (%)]	Total [n (%)]
Infectious keratitis	85 (34.3)	70 (30.3)	91 (33.2)	70 (25.6)	97 (29.5)	129 (37.3)	542 (31.8)
HSK	55 (22.2)	56 (24.2)	48 (17.5)	43 (15.7)	47 (14.3)	50 (14.5)	299 (17.6)
Corneal scarring	47 (19)	40 (17.3)	57 (20.8)	38 (13.9)	54 (16.4)	33 (9.5)	269 (15.9)
Keratoconus	13 (5.2)	20 (8.7)	26 (9.4)	57 (20.8)	53 (16.1)	50 (14.5)	219 (12.9)
Bullous keratopathy	12 (4.8)	6 (2.6)	17 (6.2)	19 (6.9)	34 (10.3)	30 (8.7)	118 (6.9)
Regrafting	13 (5.2)	9 (3.9)	9 (3.3)	13 (4.7)	13 (4.0)	20 (5.8)	77 (4.5)
Corneal dystrophy and degeneration	14 (5.7)	6 (2.6)	9 (3.3)	6 (2.2)	17 (5.2)	15 (4.3)	67 (3.9)
Others	9 (3.6)	24 (10.4)	17 (6.2)	28 (10.2)	14 (4.2)	19 (5.4)	111 (6.5)
Total	248 (100)	231 (100)	274 (100)	274 (100)	329 (100)	346 (100)	1702 (100)

Indications of Penetrating Keratoplasty in Northern India

Parul Sony, MD,* Namrata Sharma, MD,* Seema Sen, MD,† and Rasik B. Vajpayee, MS, FRCSEd*

(*Cornea* 2005;24:989–991)

TABLE 1. Indications for Penetrating Keratoplasty in Northern India

Category	No.	%	Subcategory	No.	%
Corneal scarring	769	38.03	Healed keratitis	401	19.83
			Trauma	338	16.71
			SJ syndrome	6	0.29
			Others	24	1.18
Acute infective keratitis	574	28.38			
Bullous keratopathy	272	13.45	PBK	125	6.18
			ABK	147	7.27
Failed graft	234	11.5			
Corneal dystrophy	78	3.85	CHED	39	1.92
			Macular dystrophy	15	0.74
			Fuchs dystrophy	15	0.74
			Others	9	0.45
Keratoconus	48	2.37			
Degeneration	13	0.64			
Others	34	1.68			

ABK, aphakic bullous keratopathy; PBK, pseudophakic bullous keratopathy; CHED, congenital hereditary endothelial dystrophy; SJ, Stevens-Johnson.

period from June 1997 to November 2003

N: 2022 penetrating keratoplasties

Corneal infections either active or healed are the most common indication for keratoplasty in northern India.

Major shifts in corneal transplantation procedures in north China: 5316 eyes over 12 years.

Br J Ophthalmol 2009 Oct;93(10):1291-5

Xie L, Qi F, Gao H, Wang T, Shi W, Zhao J

4346 patients (5316 eyes)

LKPs and PKPs were performed on 1558 eyes (29.3%) and 3758 eyes (70.7%), respectively
Between 1996 and 2007

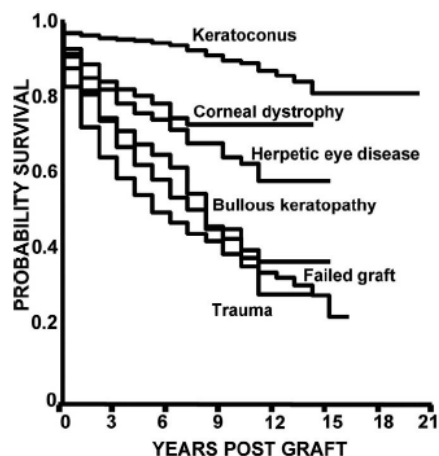
	LKP	PKP
1996-8	chemical burns, keratoconus and corneal dermoid	viral keratitis, suppurative keratitis and corneal scarring
2005-7	suppurative keratitis, keratoconus and viral keratitis	suppurative keratitis, viral keratitis and bullous keratopathy

The ratio of LKP to PKP operations tended to increase

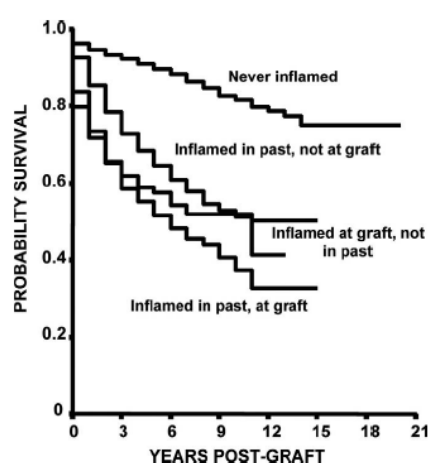
The Impact of Corneal Allograft Rejection on the Long-Term Outcome of Corneal Transplantation

DOUGLAS J. COSTER, FRACO, AND KERYN A. WILLIAMS, PhD

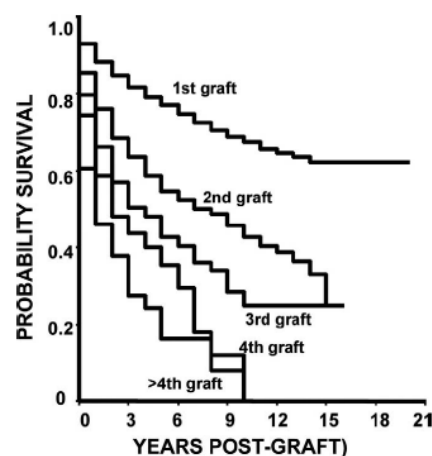
(Am J Ophthalmol 2005;140:



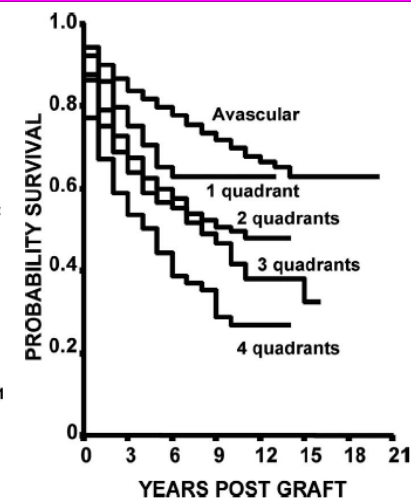
Patologia iniziale



Infiammazione



Ri-trapianti



Vascularizzazione

• RESULTS: Corneal graft outcome is not improving with era. The sequelae of inflammation, whether occurring before corneal transplantation or subsequently, exert a profound influence by predisposing the graft to rejection.

• CONCLUSIONS: Corneal allograft rejection remains a major cause of graft failure. High-level evidence to vindicate the use of a particular approach or treatment to prevent or treat corneal graft rejection is lacking. In the

Indications to penetrating surgery

Curvature

- ✓ **Keratoconus**
- ✓ **Corneal ectasia:**
 - Pellucid
 - Terrien
- ✓ **Keratoglobus**

Transparency

- ✓ **Endothelial failure**
 - pseudofachia
 - afachia
- ✓ **Regraft**
- ✓ **Stromal dystrophies**
- ✓ **Primary endotheliopathy**
 - Fuchs dystrophy
 - S Chandler
 - Endothelial dystrophies.
- ✓ **Infectious scar**
- ✓ **Congenital opacities**

Acute pathology

- ✓ **Perforazioni infettive**
- ✓ **Perforazioni infiammatorie**
 - Artrite reumatoide
 - Granulomatosi
 - Ulcera di Mooren
 - Vasculiti sistemiche
 - S. Sjogren
- ✓ **Perforazioni traumatiche**

When to consider A PK



✓ In presence of an absolute indication:

**Corneal perforation
Descemet's rupture
"a chaud" keratoplasty
AC reconstructive surgery.**

✓ In presence of intraoperative complication

**macro-perforation of Descemet M. in DALK
Need for conversion in DSAEK**

✓ When new technologies may improve final results of a penetrating procedure (femtosecond)

Deep infectious keratitis



Perforations and descemetocoele



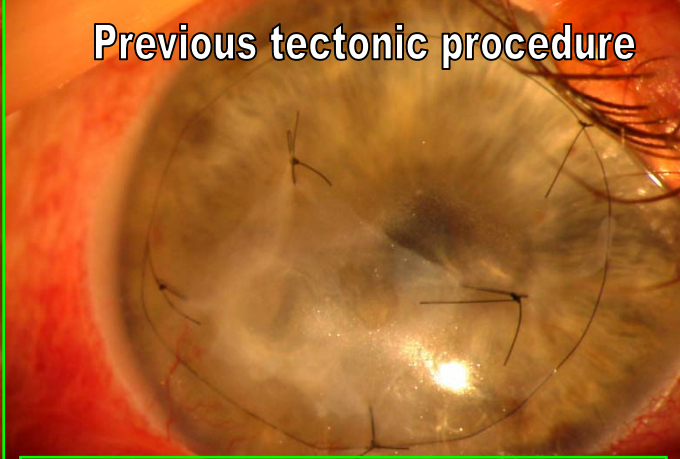
Infectious thinning



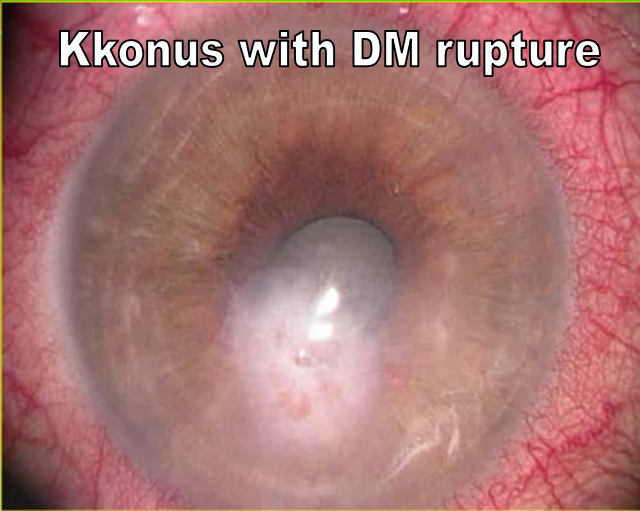
Graft infections



Previous tectonic procedure



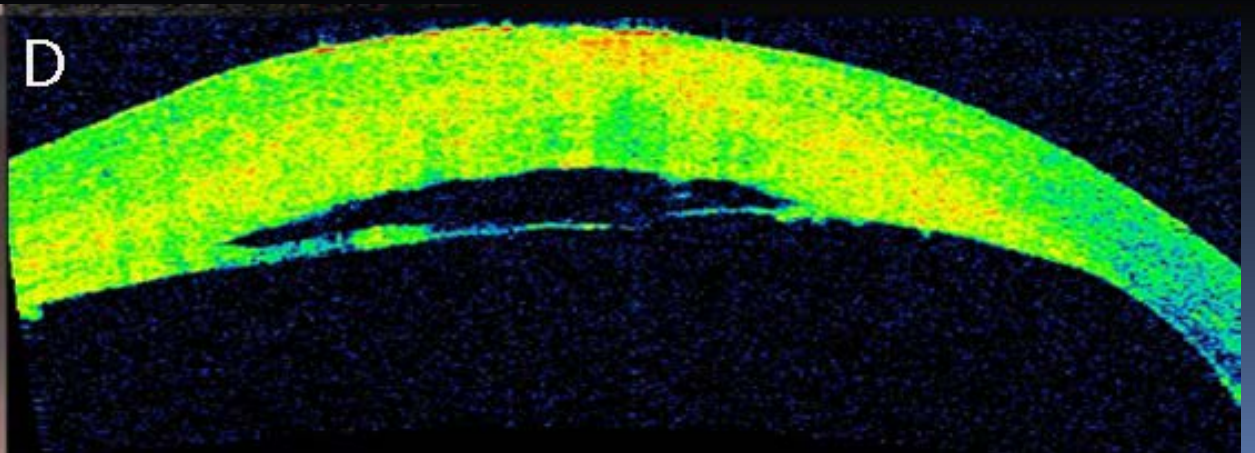
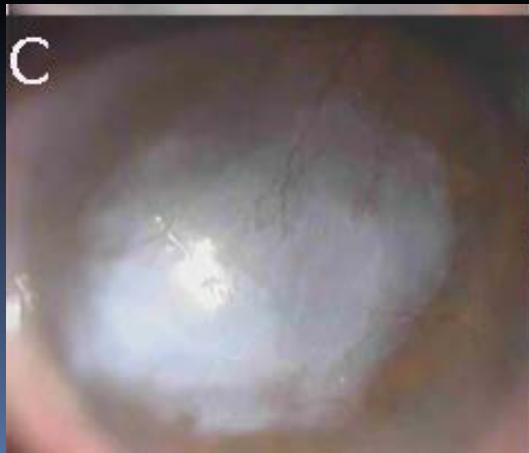
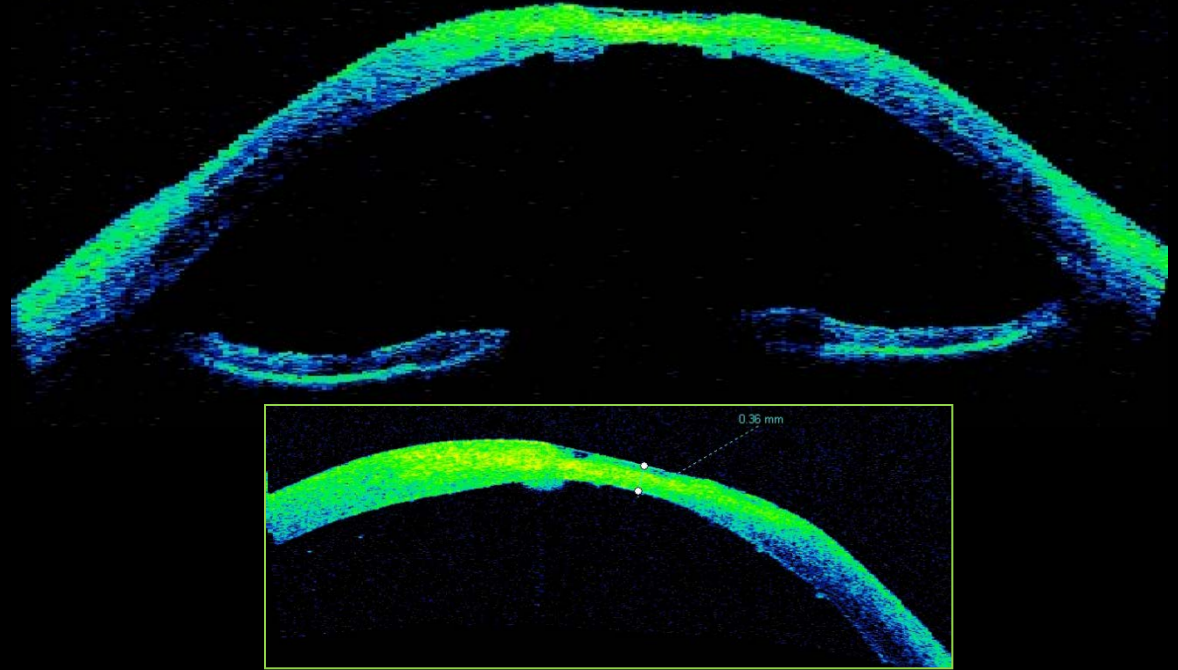
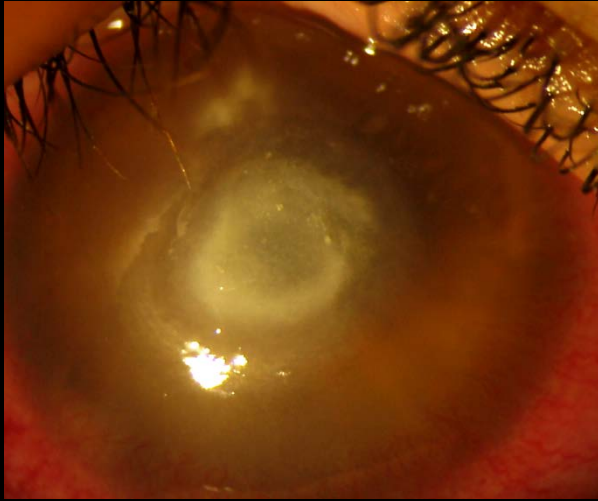
Kkonus with DM rupture



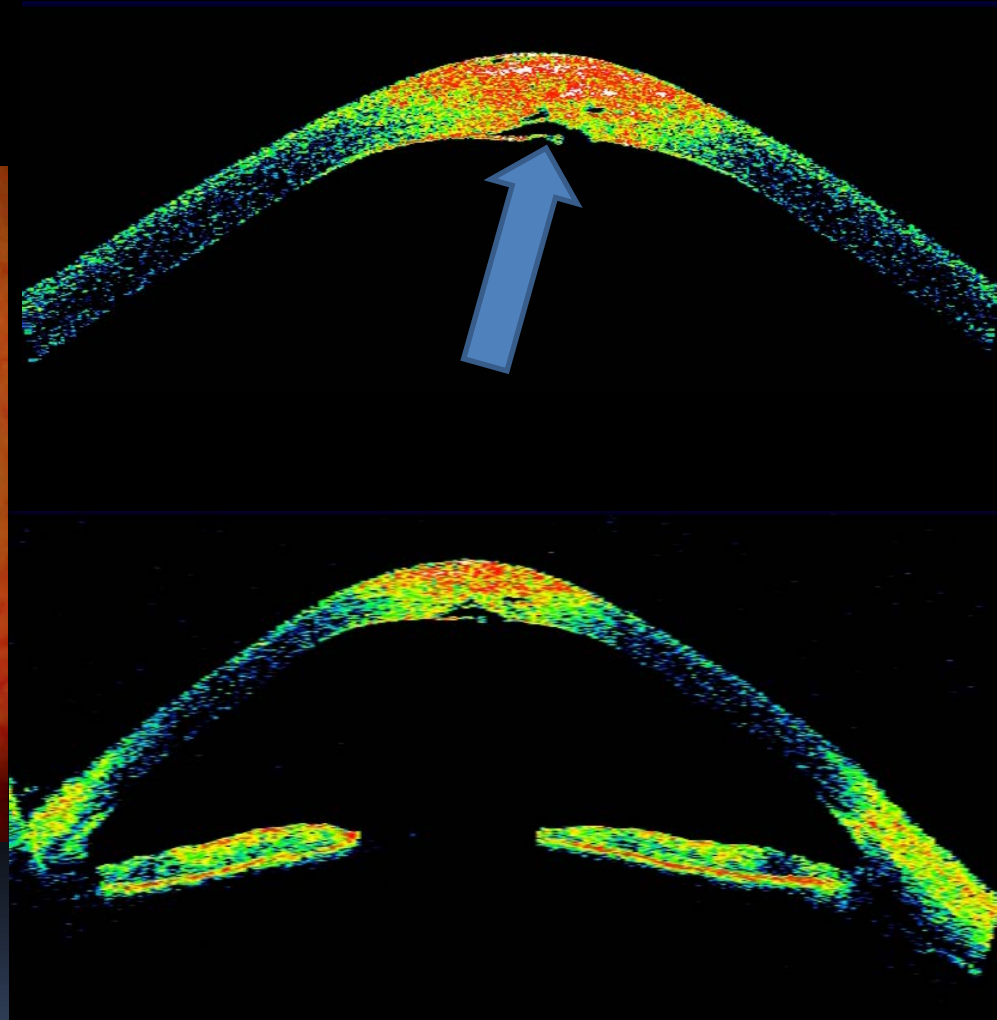
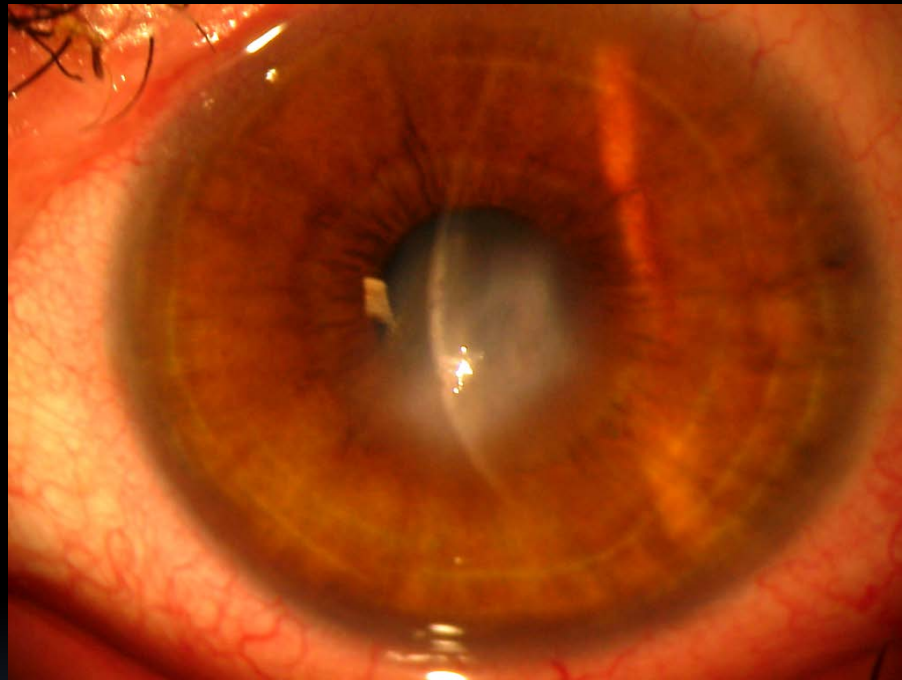
Acute corneal hydrops



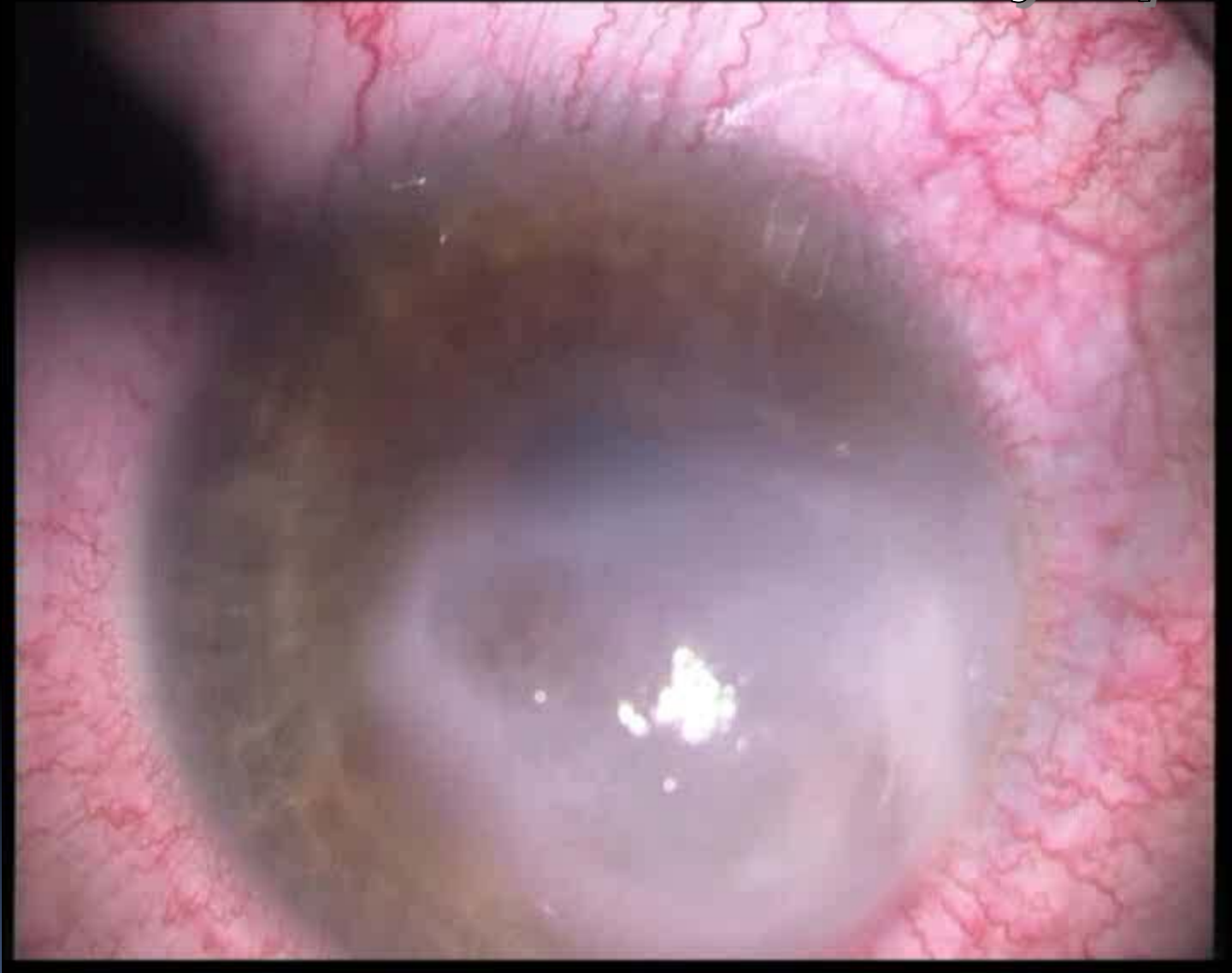
Posterior imaging in non-transparent corneas may help in PK selection



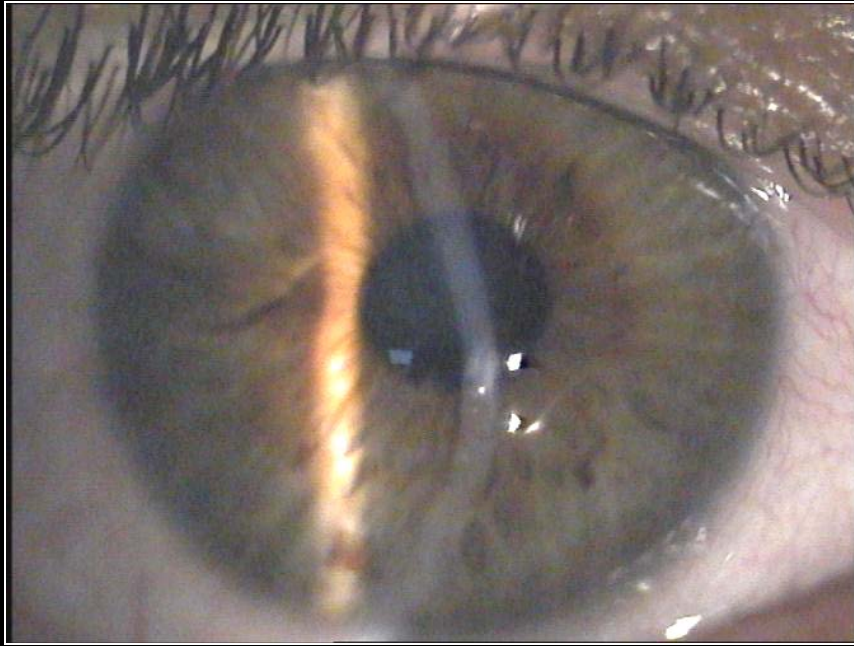
Acute corneal hydrops in Kkonus due to DM rupture



PK with cauterization for acute hydrops



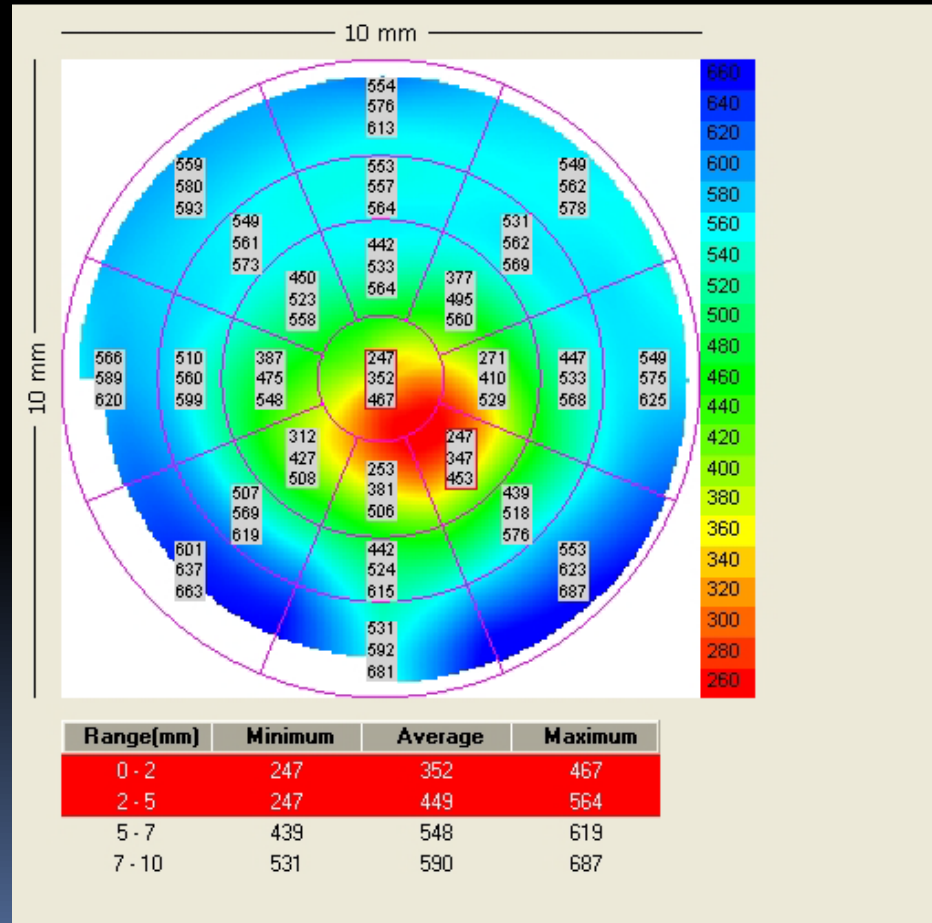
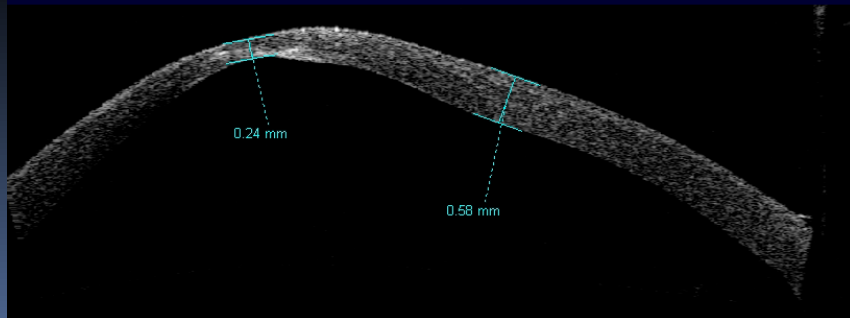
Keratoconus with DM scarring



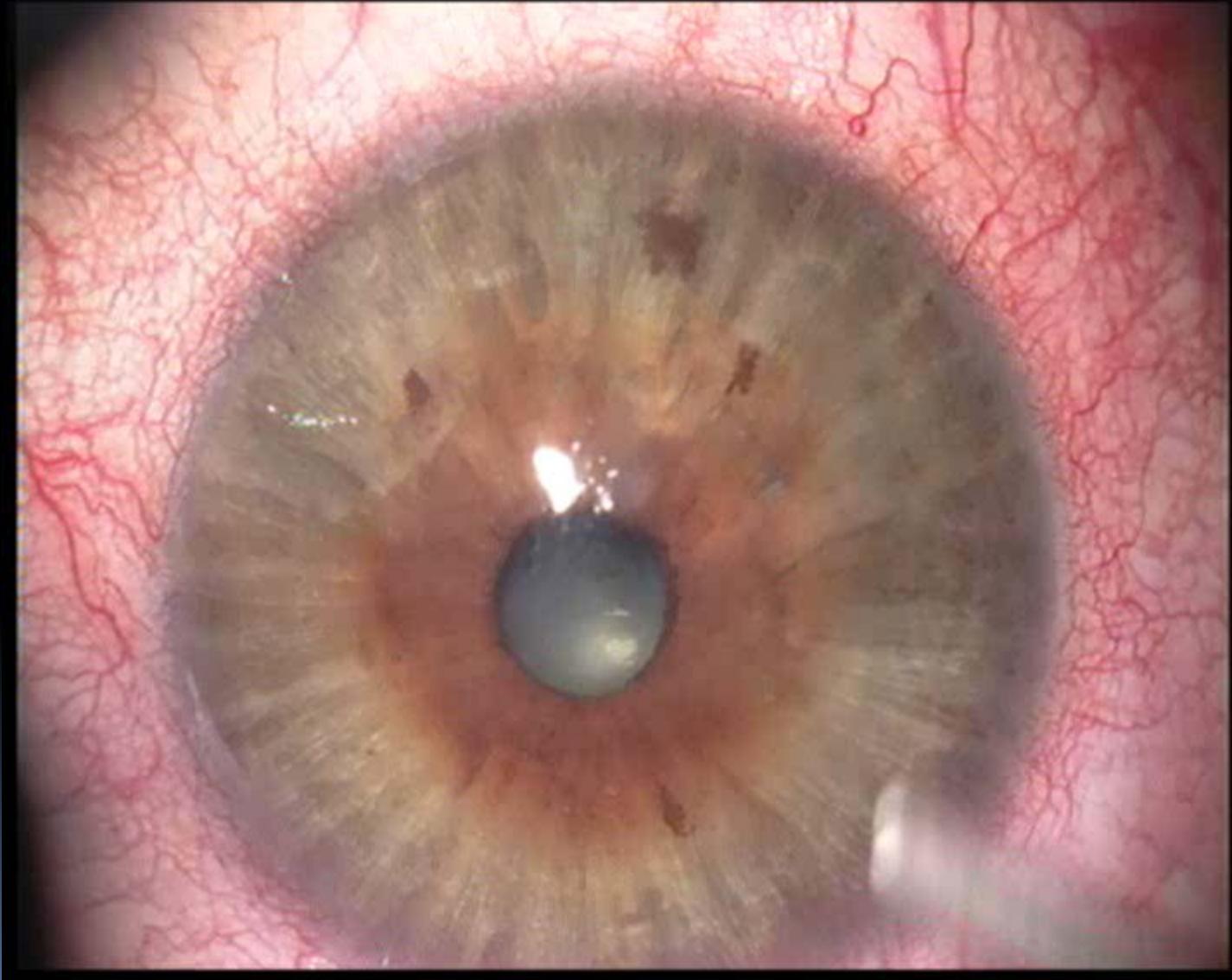
Visante™ OCT
ANTERIOR SEGMENT IMAGING



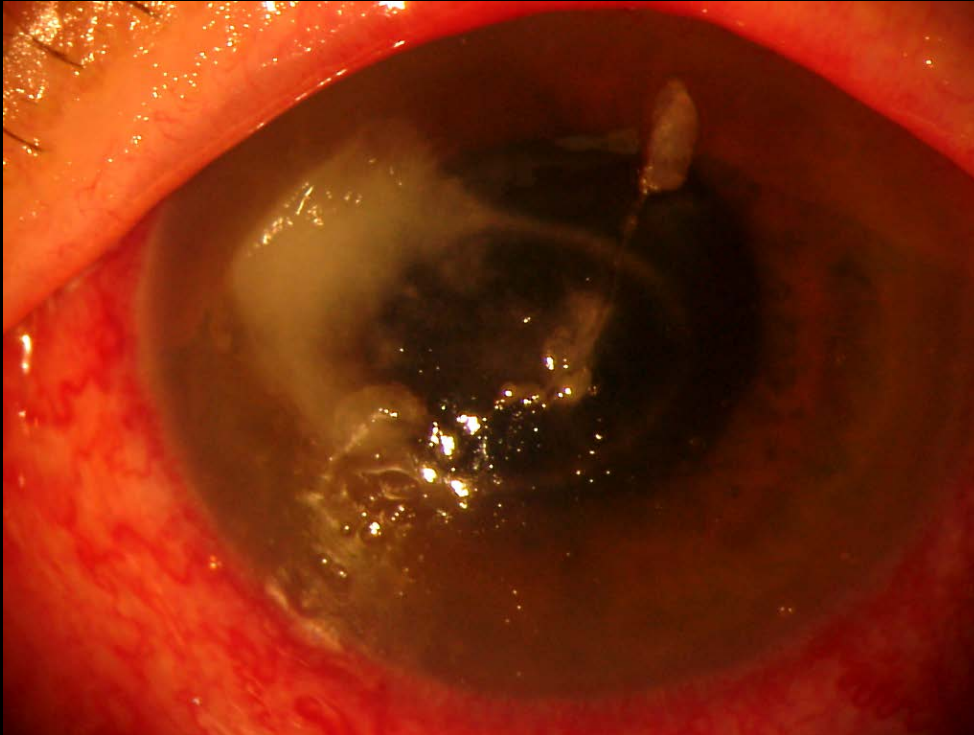
SW Version: 2.0.1.88 Patient ID: Gender: Unknown Age: 53
High Res. Corneal



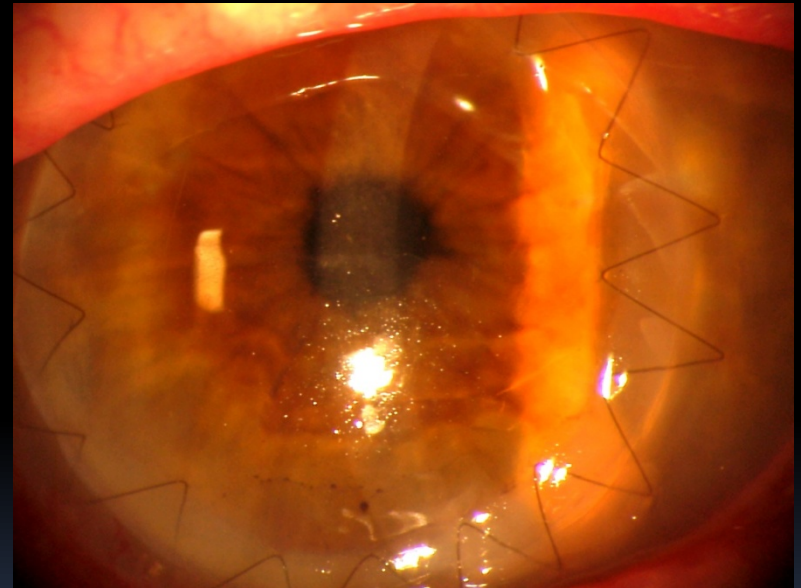
PK with apex cautherization in Kkonus with DM scarring



Severe corneal infection in OGVHD

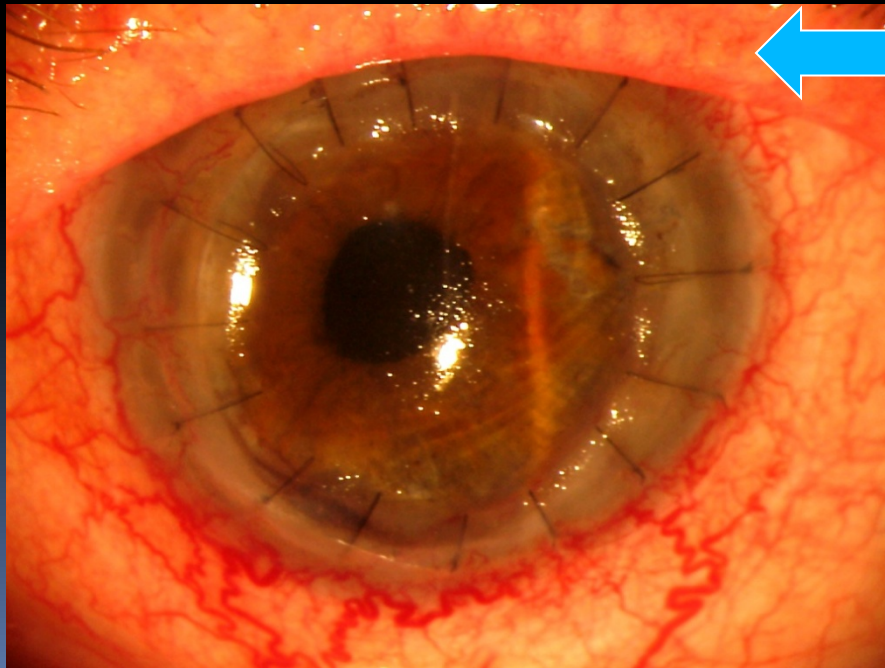
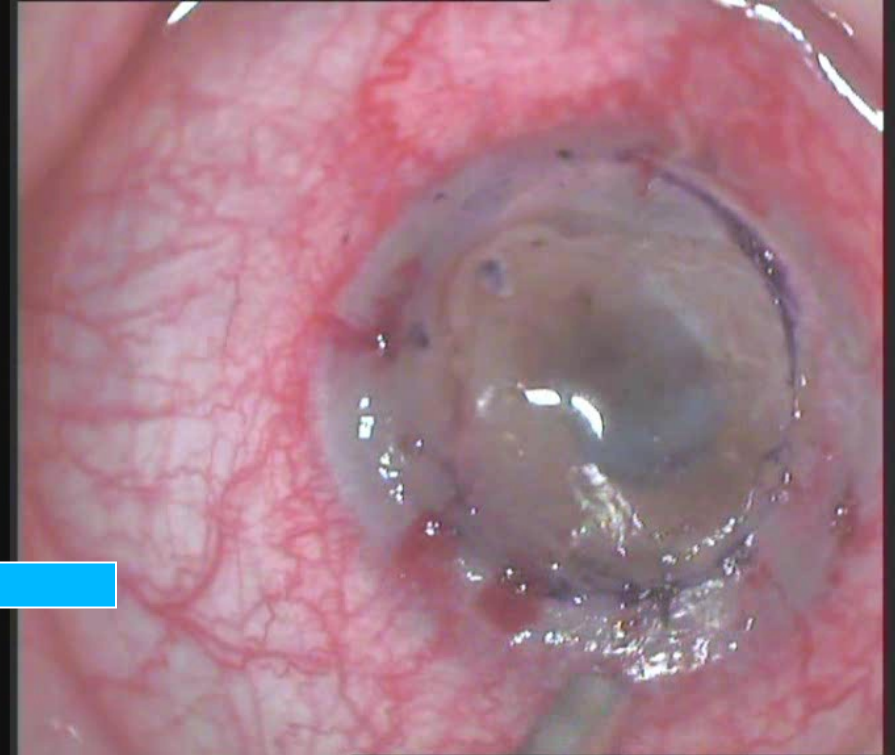
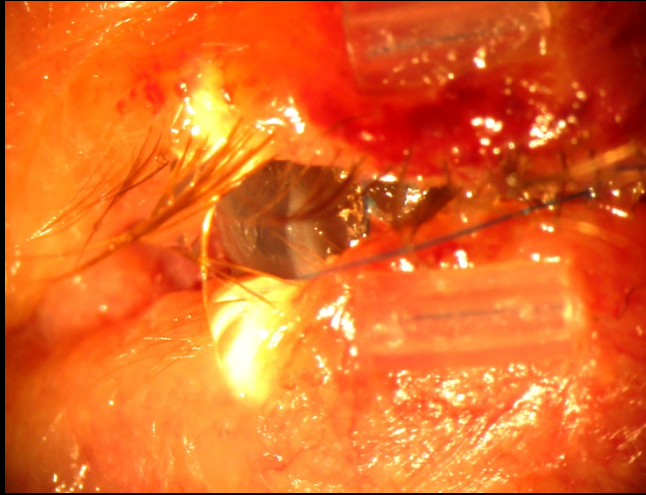


Urgent therapeutical procedure in the lack of efficient antibiotic therapy



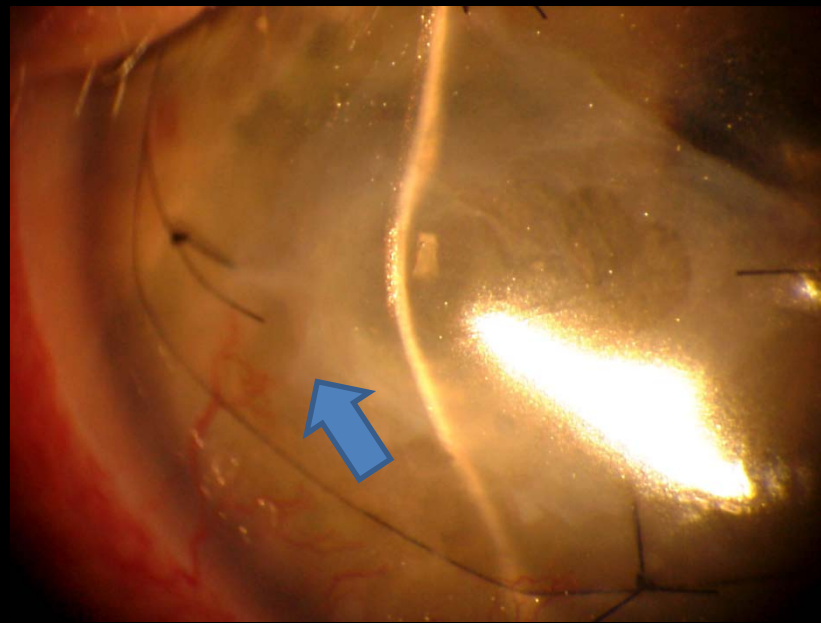
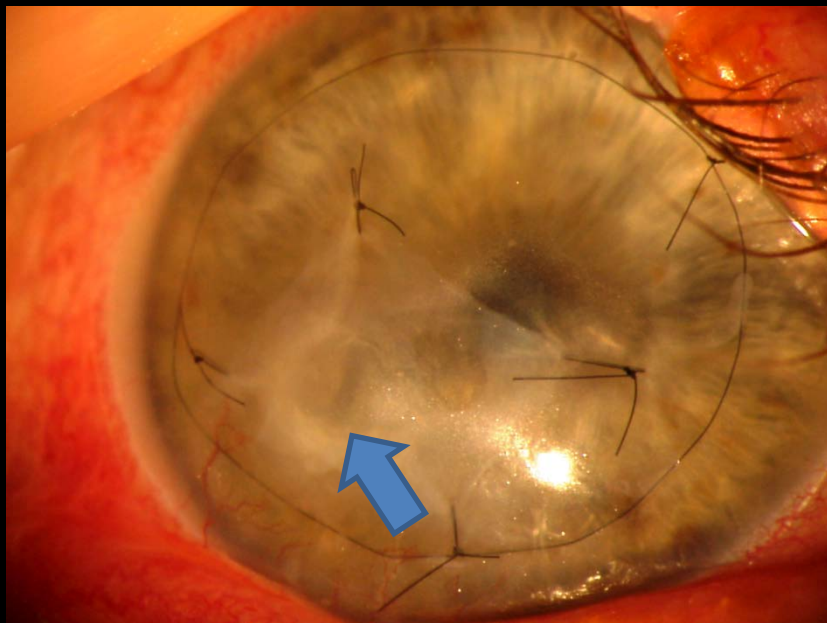
Corneal abscess due to Candida Albicans + Stenotrophomonas Maltophilia in immunosuppressed one-eyed patient (GVHD)

Extensive corneal melting with large perforation

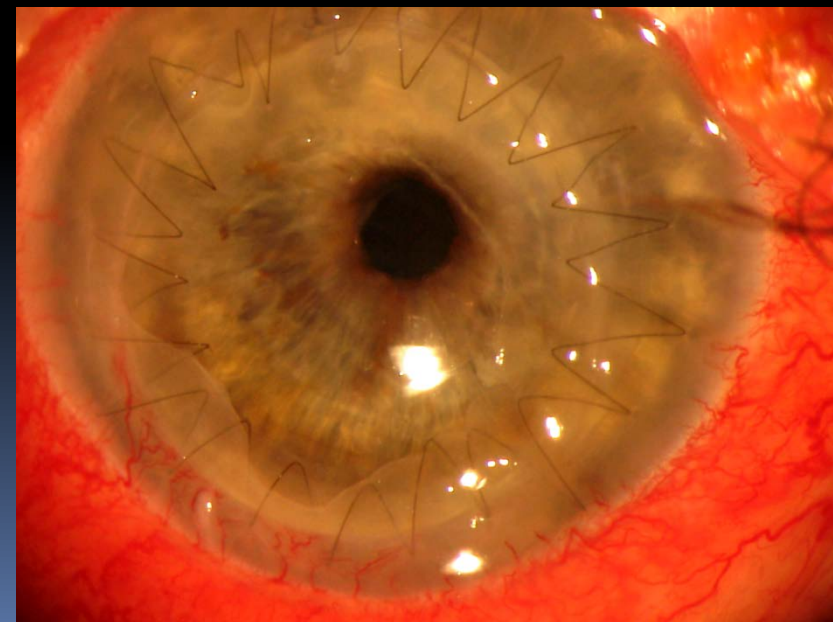
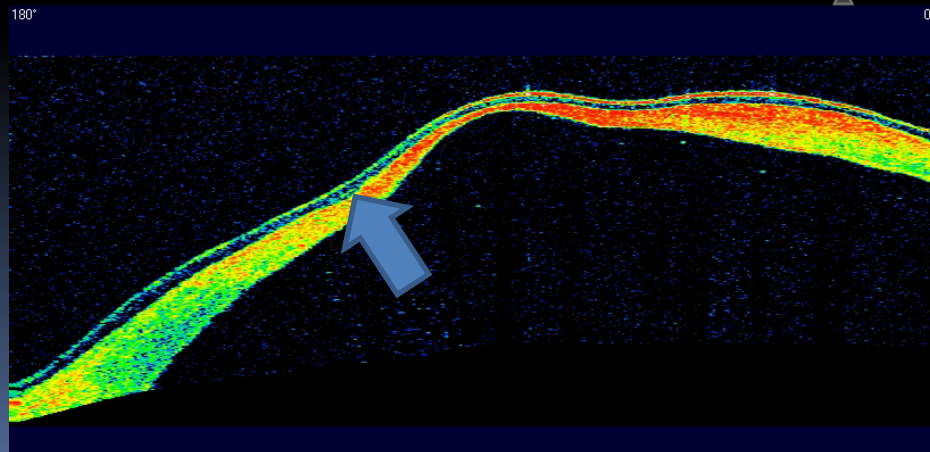


*In presence of acute melting with perforation
PK needs to be performed in emergency,
Often free hand, due to difficulties in
effective trephination*

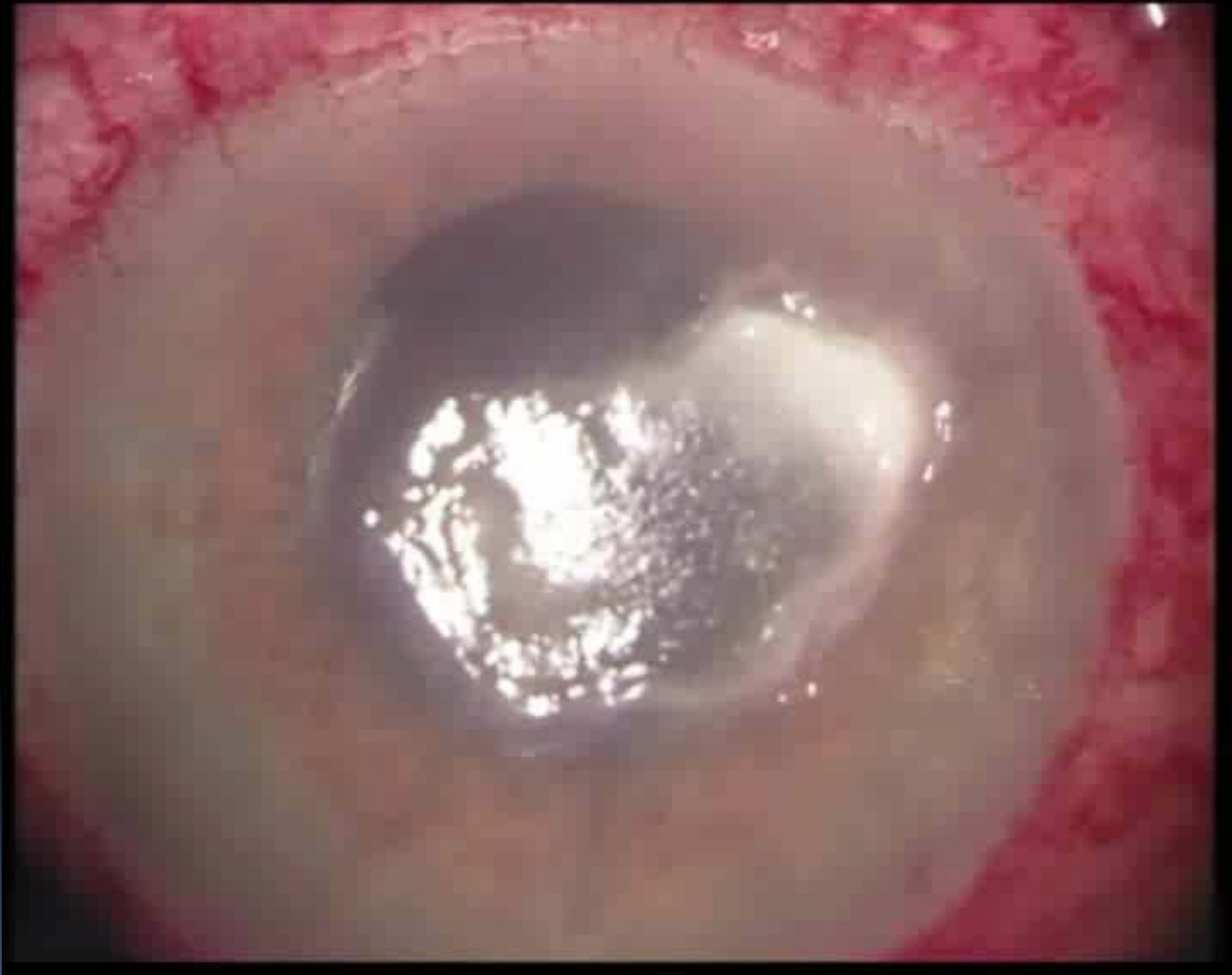
PK in Descemetocoele with peripheral thinning After AMT reconstruction for deep infectious ulcer



SW Version: 2.0.1.88 Patient ID: Gender: Male Age: 65
High Res. Corneal Quad



DALK attempt and conversion to PK



FSL PKs benefit from wound configuration ***Not achievable in standard mechanical trephination PK***

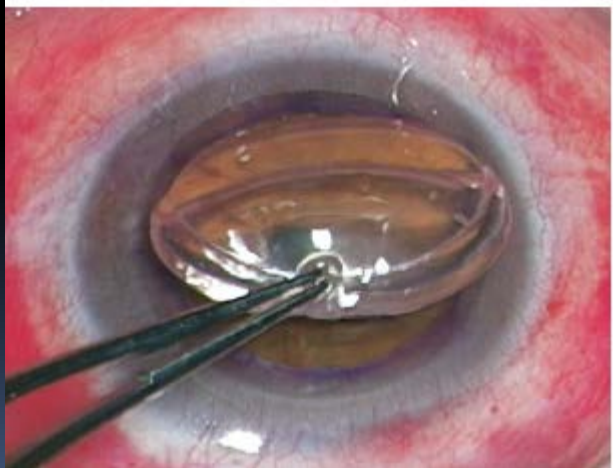
Femtosecond Laser Shaped Penetrating Keratoplasty:
One-year Results Utilizing a Top-hat Configuration

Am J Ophthalmol 2008;

FRANCIS W. PRICE, JR AND MARIANNE O. PRICE

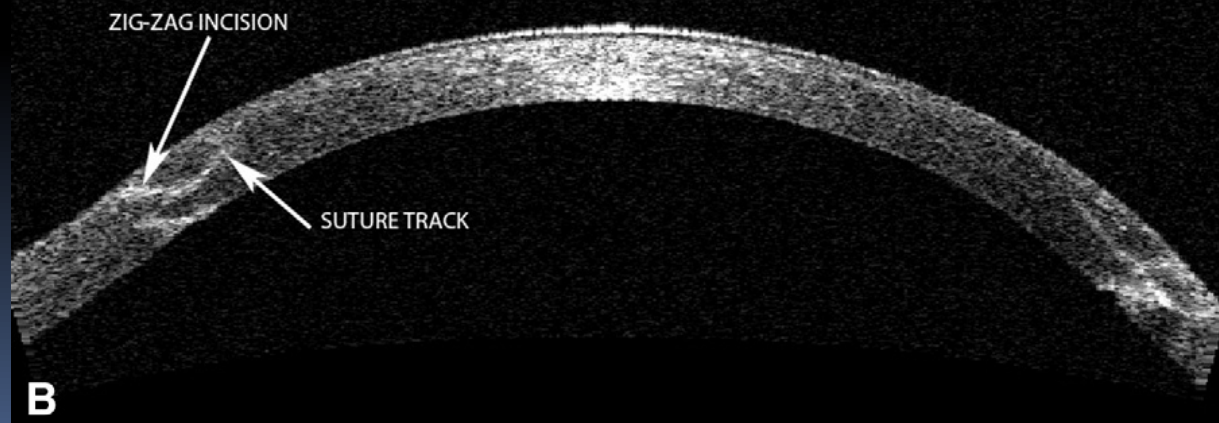


FIGURE 1. Illustration of the femtosecond laser-shaped penetrating keratoplasty (PK) "top-hat" graft configuration.



Results of Penetrating Keratoplasty Performed with a Femtosecond Laser Zigzag Incision Initial Report

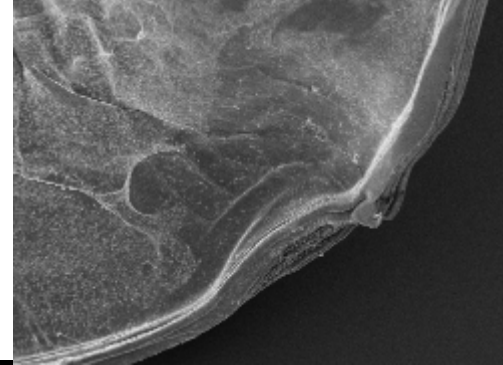
Marjan Farid, MD, Matthew Kim, MD, Roger F. Steinert, MD



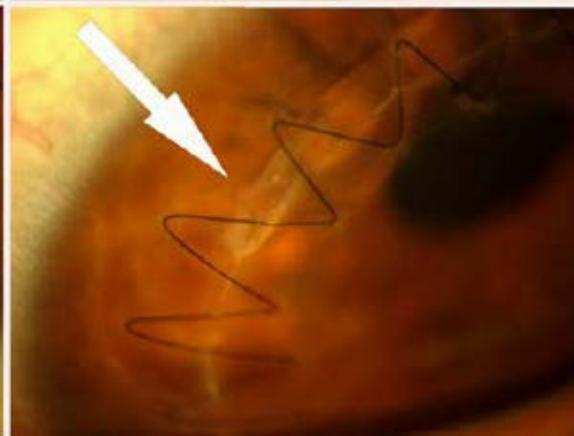
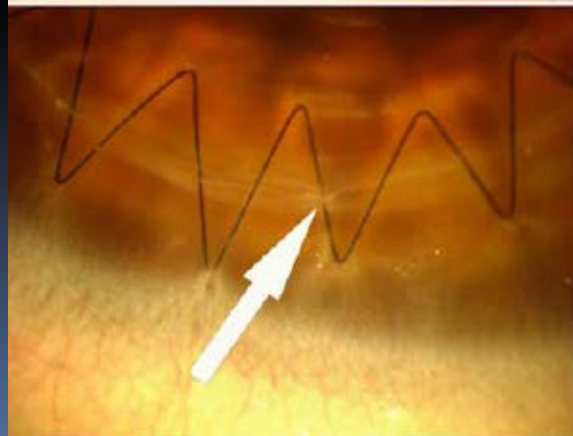
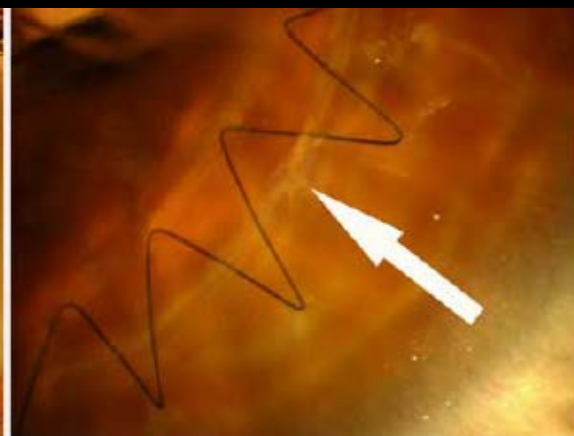
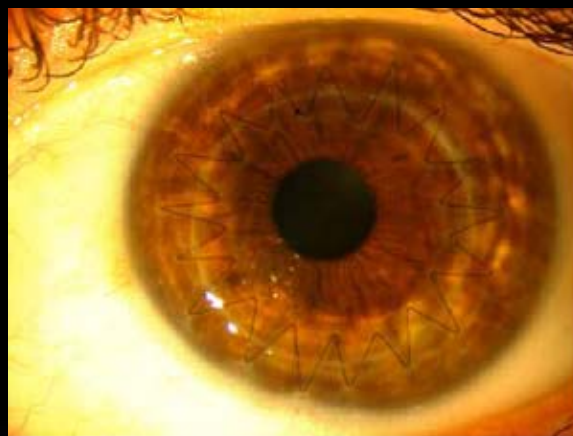
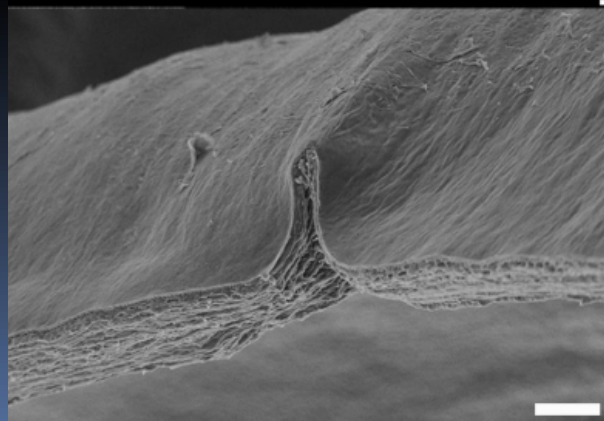
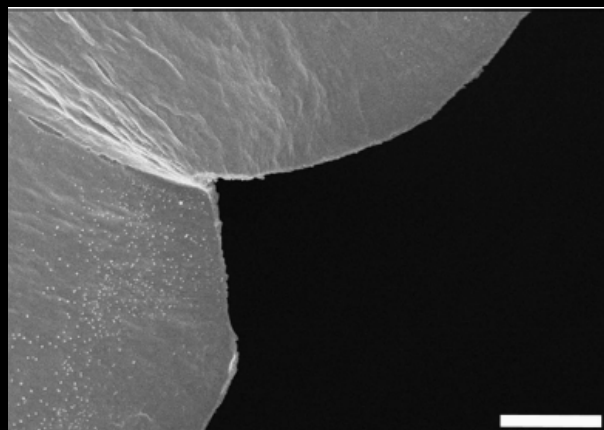
Orientation Teeth in Nonmechanical Femtosecond Laser Corneal Trephination for Penetrating Keratoplasty

Am J Ophthalmol 2008;

LEONARDO MASTROPASQUA, MARIO NUBILE, MANUELA LANZINI, ROBERTA CALIENNO,
AND ORIANA TRUBIANI



Complex geometry in FSL keratoplasty



Outcomes of Femtosecond Laser-Assisted Penetrating Keratoplasty

Am J Ophthalmol 2008;

YONG M. POR, JACOB Y. CHUAN CHENG, ANAND PARTHASARATHY, JODHBIR S. MEHTA,
AND DONALD T. H. TAN

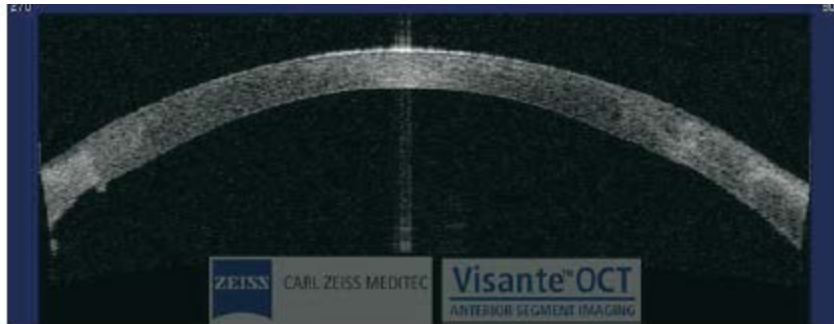


FIGURE. Representative anterior segment optical coherence tomography (ASOCT) image of Patient 7 following femtosecond laser-assisted penetrating keratoplasty, showing perpendicularly cut recipient/donor edges, which are perfectly apposed.

TABLE. Patient Diagnoses, Operative Details, and Outcomes Following Femtosecond Laser-Assisted Penetrating Keratoplasty

Patient No.	Diagnosis	Preoperative BCVA	Suture Type	Donor Diameter (Projected/Chord Length)	Recipient Diameter (Projected/Chord Length)	Three-month BCVA	Refraction Three Months	Best Vision	Refraction Latest Follow-up
1	BK (trauma)	CF 1 m	16 interrupted	7.75	7.75	20/80	+3.00/-4.00×50	20/80	+1.00/-4.50×60
2	BK (laser PI)	CF 2 m	Double continuous 8 bite	7.75	7.5	20/30	+4.00/-1.50×55	20/30	+5.00/-0.50×55
3	Failed graft (PK for keratoconus)	CF 2 m	Double continuous 8 bite	8.25	8.00	20/70	+3.75/-1.50×160	20/70	+3.75/-1.50×160
4*	BK (Fuchs dystrophy)	HM	16 interrupted	8.25	7.75	CF 2 m	+3.00/-3.50×30	CF 2 m	+2.00/-2.50×20
5	Failed graft	20/400	Double continuous 8 bite	8.50	8.00	20/30	-2.75/-1.00×45	20/30	-3.00/-2.75×35
6†	Pseudophakic BK	CF 3 m	16 interrupted	8.80	8.45	CF 2 m	+3.00/-5.50×60	20/400	PI/-4.00×120
7	Herpetic corneal scarring	CF 1 m	16 interrupted	7.75	7.50	20/40	+2.00/-0.50×180	20/20	+3.25/-1.25×145
8	Pseudophakic BK	CF 2 m	Double continuous 8 bite	8.50	8.25	20/80	-0.75/-2.75×160	20/80	-3.00/-3.50×170

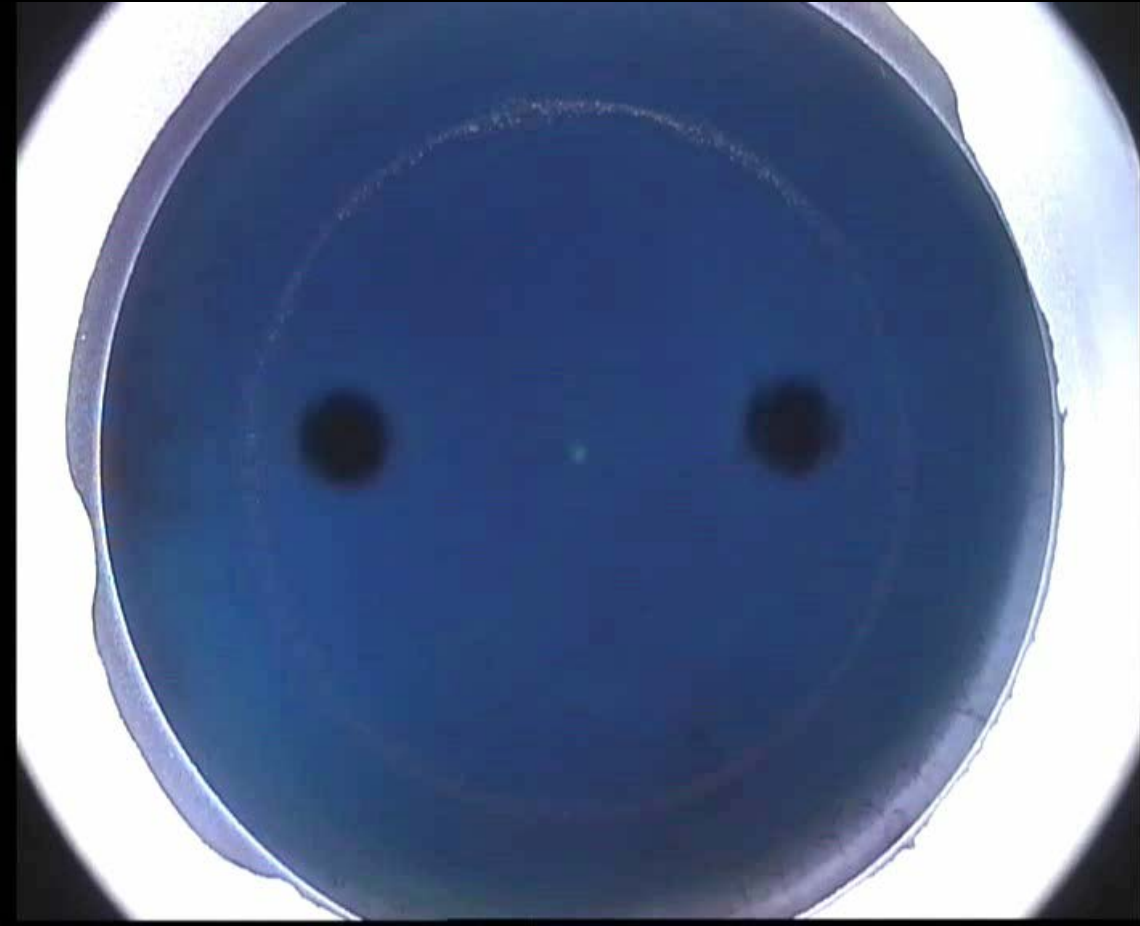
BK = bullous keratopathy; BCVA = best-corrected visual acuity; CF = counting fingers; HM = hand motions; PI = peripheral iridotomy; PK = penetrating keratoplasty.

*Poor BCVA because of diabetic macular edema.

†Poor BCVA because of epiretinal membrane with macular striae.

PENETRATING KERATOPLASTY

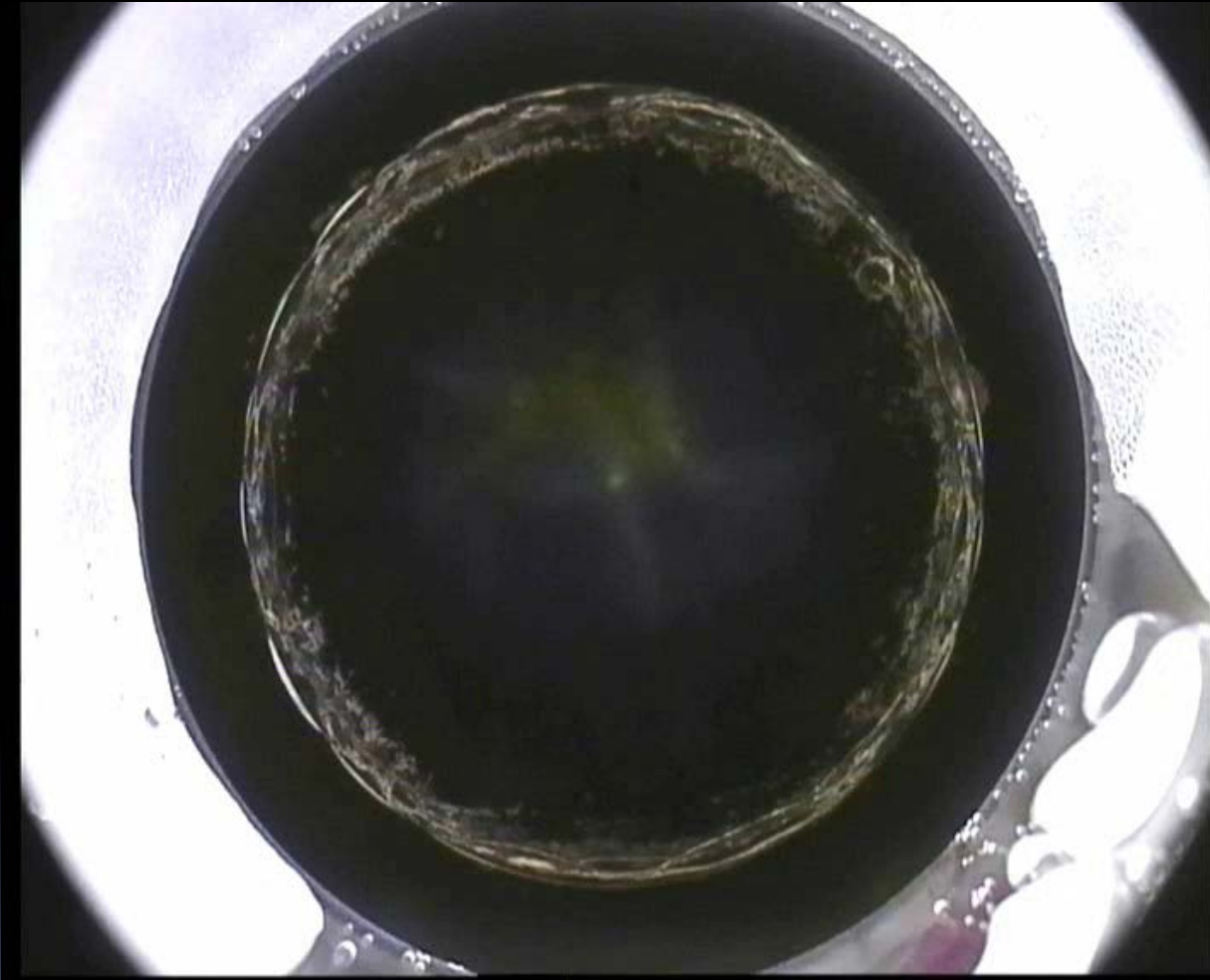
90° Visumax FSL full thickness trephination for PK



Donor button preparation in AAC

With 90° angled cut a 7.1 mm diameter is achieved on the endothelial side, while 8.1 mm on the surface

90° Visumax FSL full thickness trephination for PK



Recipient preparation (full thickness corneal scar)

0.1 mm undersized - 7.0 mm diameter is achieved on the endothelial side, while 8.0 mm on the surface

conclusions

Lamellar surgery has a worldwide strong trend of increase and will represent the majority of keratoplasty in developed countries

However standardization of DALK and DSEK procedure are still needed and PK is the reference gold standard comparison of efficacy

PK still represents the most used keratoplasty procedure in the treatment of corneal pathologies and has to be routine in the skill of the corneal surgeons