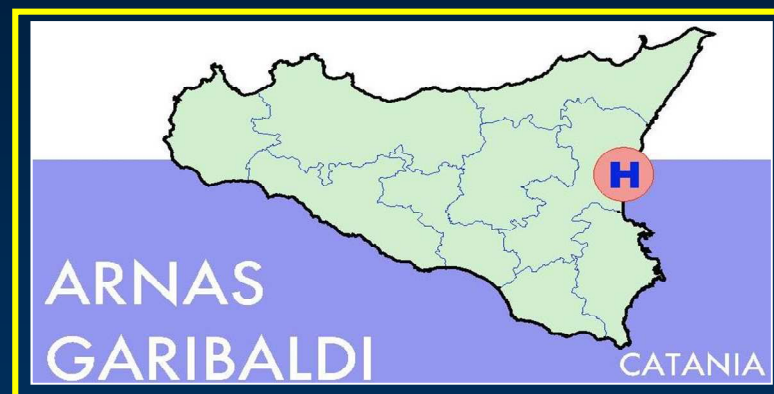


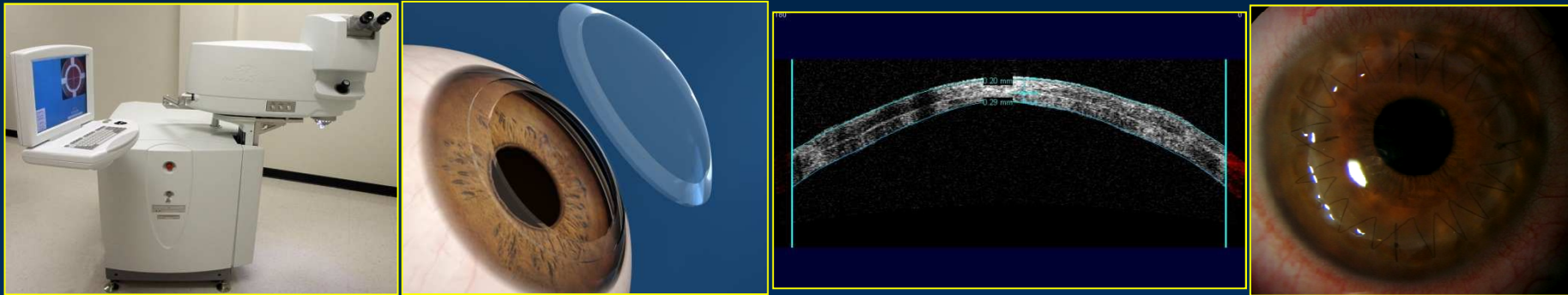
# Azienda Ospedaliera di Rilievo Nazionale e di Alta Specializzazione Garibaldi Catania



Unità Operativa Complessa di Oftalmologia

*Direttore: Dott. Antonio Rapisarda*

# Cheratoplastica perforante e lamellare anteriore con laser a femtosecondi: primi risultati



Valeria Distefano, Emilia Gallo, Lorenzo Rapisarda, Antonio Rapisarda

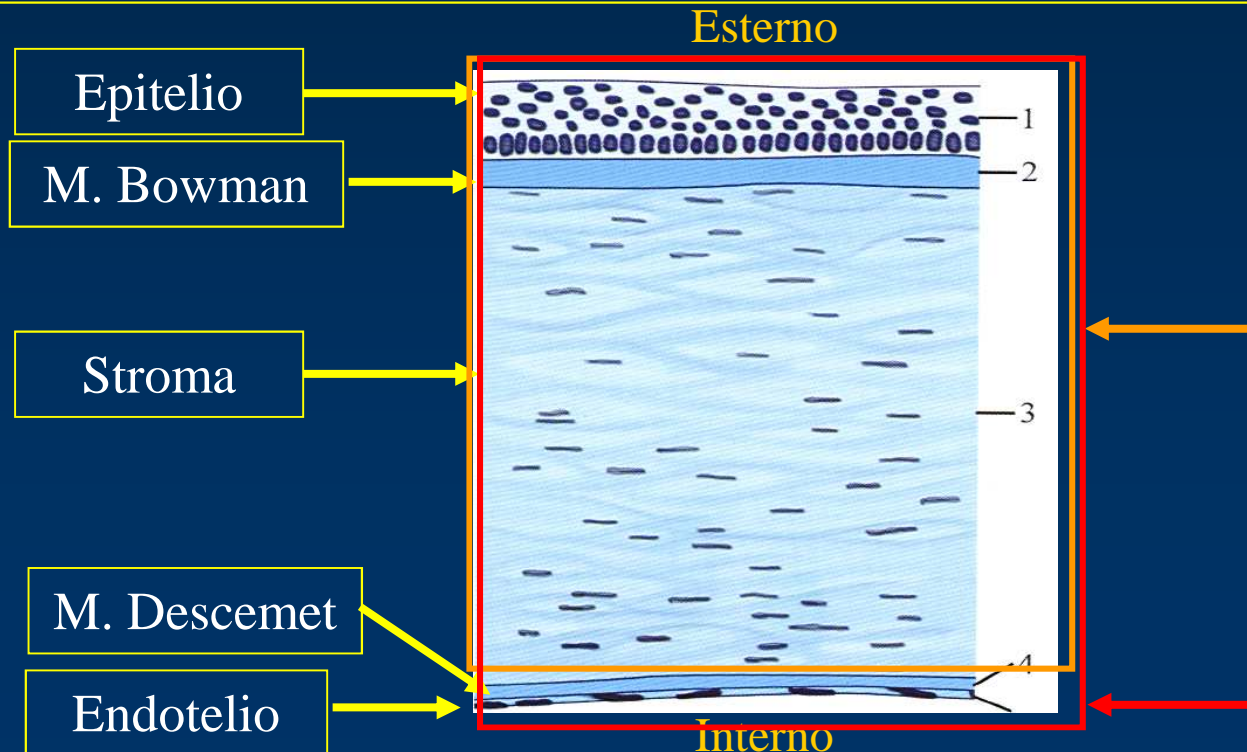
XXXV Congresso S.O.Si.

*Terrasini 15 – 17 Aprile 2010*



## Definizione

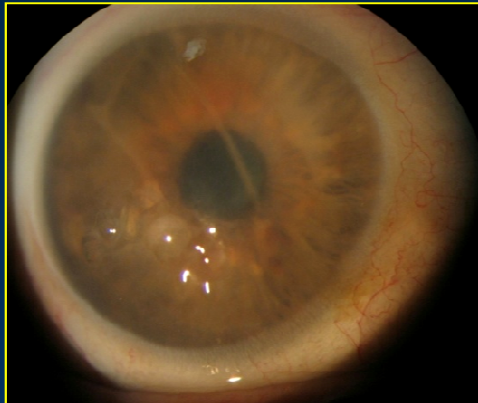
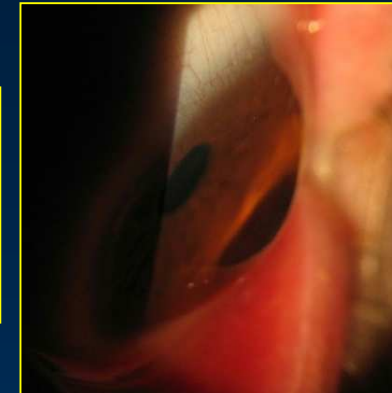
- La cheratoplastica **perforante** e **lamellare anteriore** sono due tecniche di trapianto totale e parziale (solo le strutture superficiali della cornea – epitelio, membrana di Bowman, stroma – con risparmio degli strati profondi del ricevente – membrana di Descemet ed endotelio) della cornea



## Indicazioni a PK con IEK



➤ Cheratoconi  
(III – IV stadio  
Krumeich) –  
ectasie



➤ Endoteliopatie

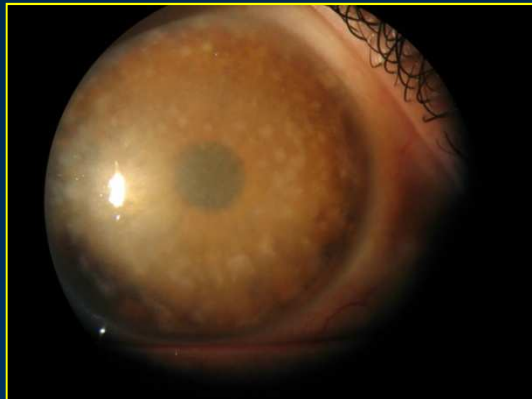
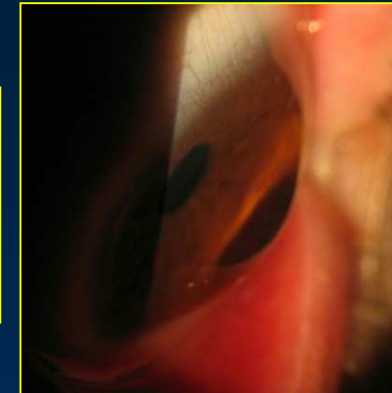
➤ Leucomi profondi  $\geq 300\mu$



## Indicazioni a LK con IEK



➤ Cheratoconi  
(I – II stadio  
Krumreich) –  
ectasie



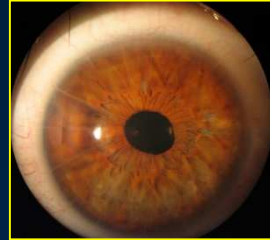
➤ Degenerazioni

➤ Leucomi superficiali  $\leq 300\mu$



# Controindicazioni

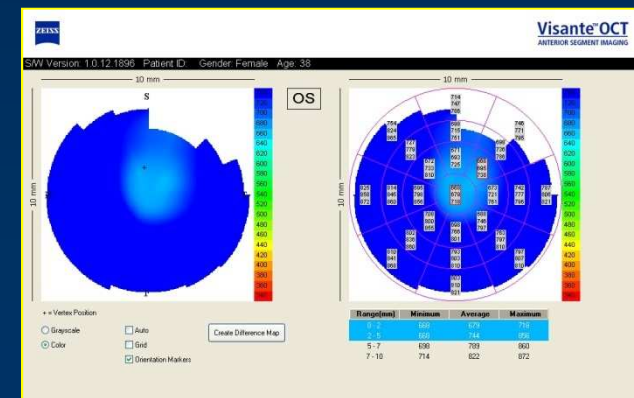
➤ precedente chirurgia incisionale



➤ opacità corneali dense che schermano l'iride (leucomi)



➤ pachimetria corneale periferica (9 mm) >1200  $\mu$





## Tecnica chirurgica



- preparazione del lembo donatore con camera artificiale

Lembo donatore  
Ø 15 – 16 mm

- anestesia topica



- preparazione del lembo corneale del ricevente

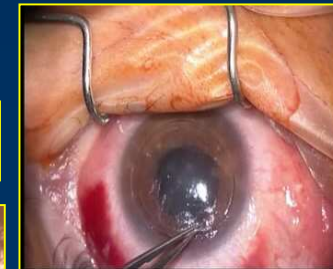


- anestesia locale o generale

- slamellamento della cornea ricevente pretagliata (DLK)

- apposizione del lembo donatore su ricevente

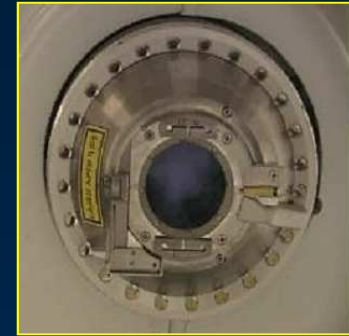
- sutura nylon 10/0 (punti staccati, continua)



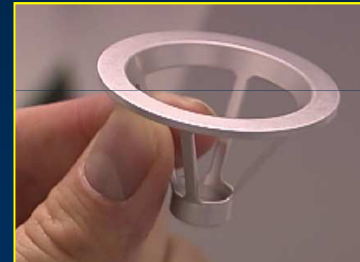
# Strumentario dedicato



Patient interface



Cono di appianazione



Anello di suzione



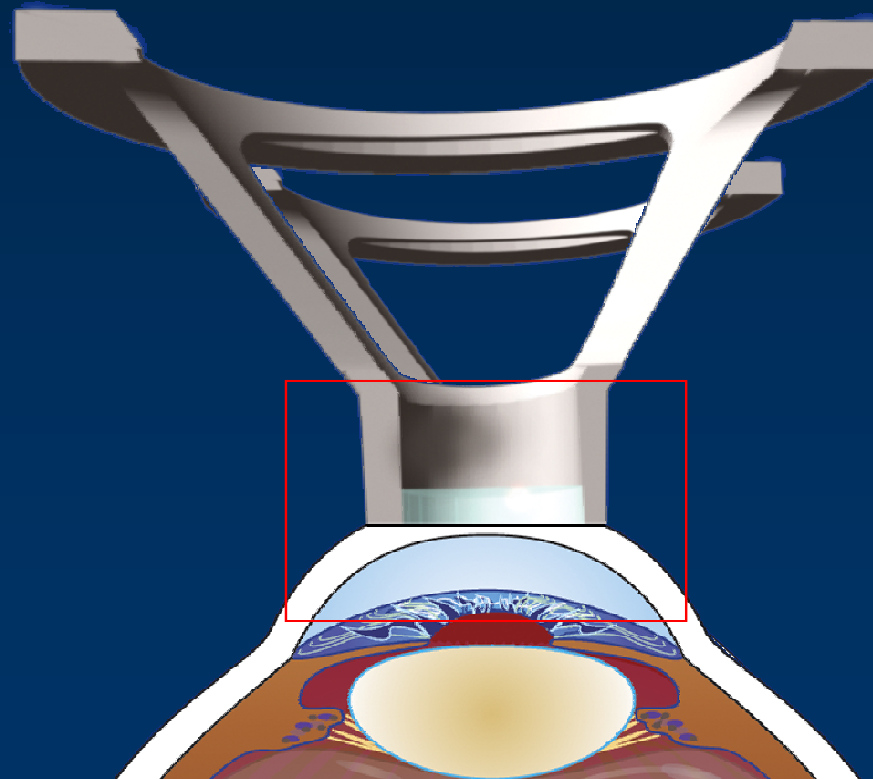
Siringa





## Perché eseguire l'applanazione ?

- L'applanazione della cornea viene effettuata mediante un cono di applanazione alla cui estremità si trova una lente di vetro piatta, che rappresenta il punto di riferimento per la giusta focalizzazione degli spot laser alla profondità desiderata.
- Flap corneale di spessore preciso che sia indipendente dalla curvatura corneale.
- Flap corneale di spessore uniforme che sia indipendente dal valore di suzione.



# INTRALASE® FS



- Microscopio operatorio
- Joystick
- Sistema per appianazione
- Pannello di controllo
- Bottone di emergenza
- Cd-rom e floppy disk
- Chiave di accensione
- Monitor e tastiera

Excimer

193 nm

Argon

457-514 nm

Diode

805-820 nm

Nd:Glass

1053 nm

Er:Yag

2940 nm

CO2

10,600 nm

**INTRALASE® FS**

100 nm

Ultravioletto

400 nm

Visibile

700 nm

Infrarosso

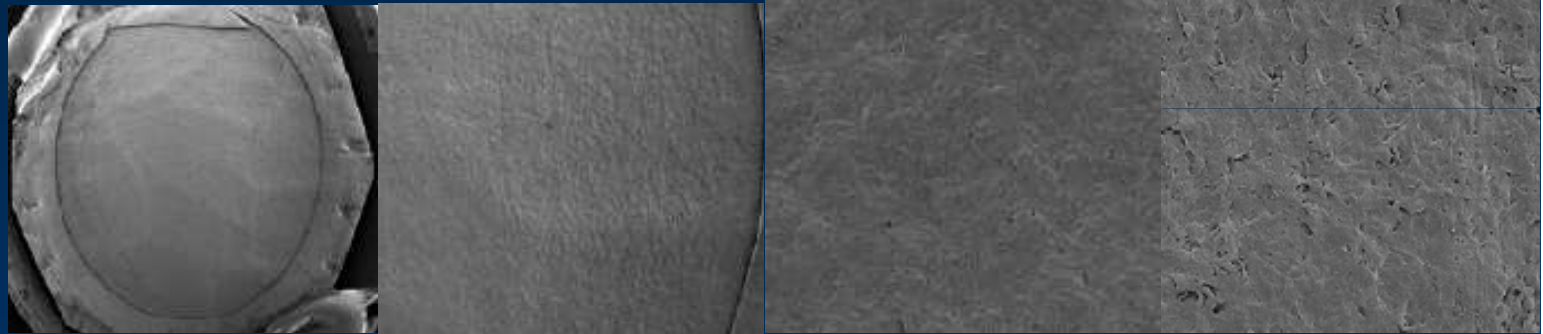
→ 100,000 nm

# INTRALASE® FS 150 – Obiettivo



- Lavorare con la minore energia possibile
- Creare un flap facilmente sollevabile
- Utilizzare un tempo sufficientemente breve
- Ottenere una superficie stromale regolare

4<sup>a</sup> generazione  
60 KHz

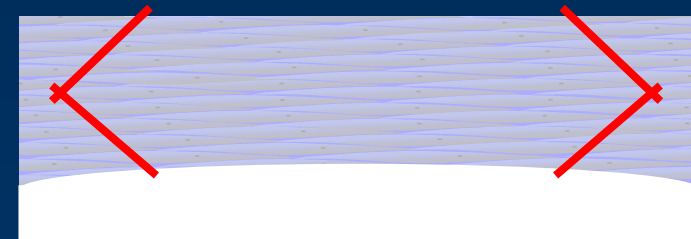
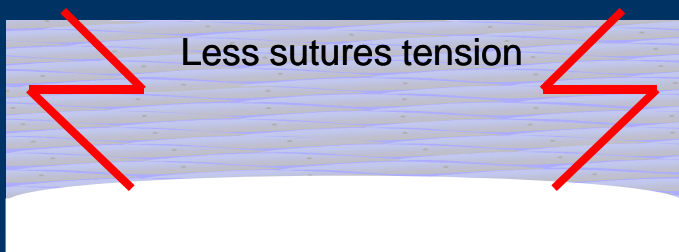
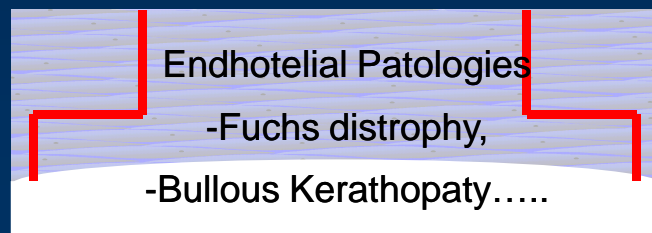
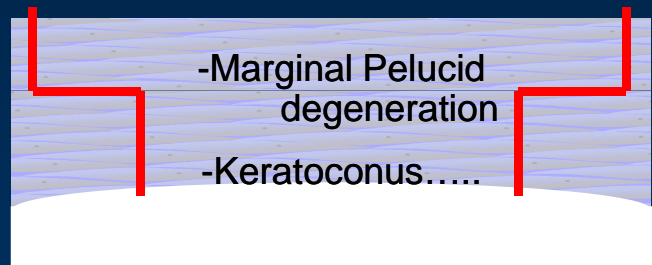


5<sup>a</sup> generazione  
150 KHz



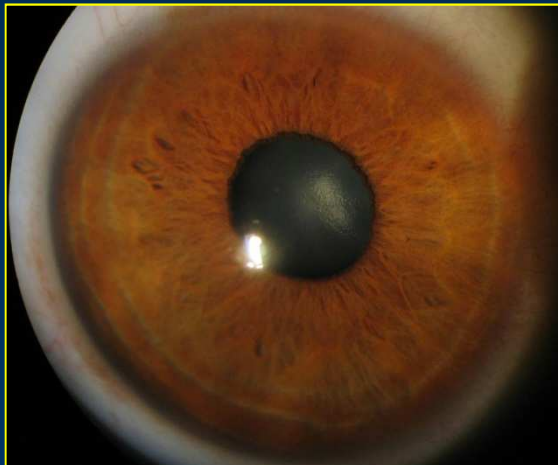
Il sistema IntraLase® FS 60 può realizzare 5 diversi segmenti di taglio che, quando combinati tra loro, possono creare svariate forme geometriche specifiche per le esigenze del chirurgo:

- Posterior Side cut
- Full Lamellar cut
- Ring Lamellar cut
- Anterior Side cut
- Full Thickness cut



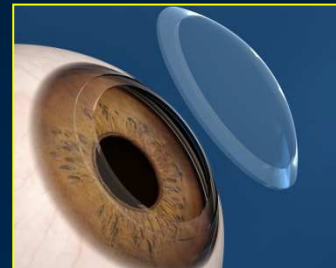
## Nostra casistica

- 10 pazienti (4 M e 6 F)
- Età compresa fra 26 e 65 anni
- 5 PK (4 cheratoconi IV stadio e 1 leucoma) e 5 ALK (3 cheratoconi III stadio e 2 distrofie di Groenouw tipo I)
- Follow – up: 3 – 5 mesi (breve)





# IEK : Intralase Enable Keratoplasty

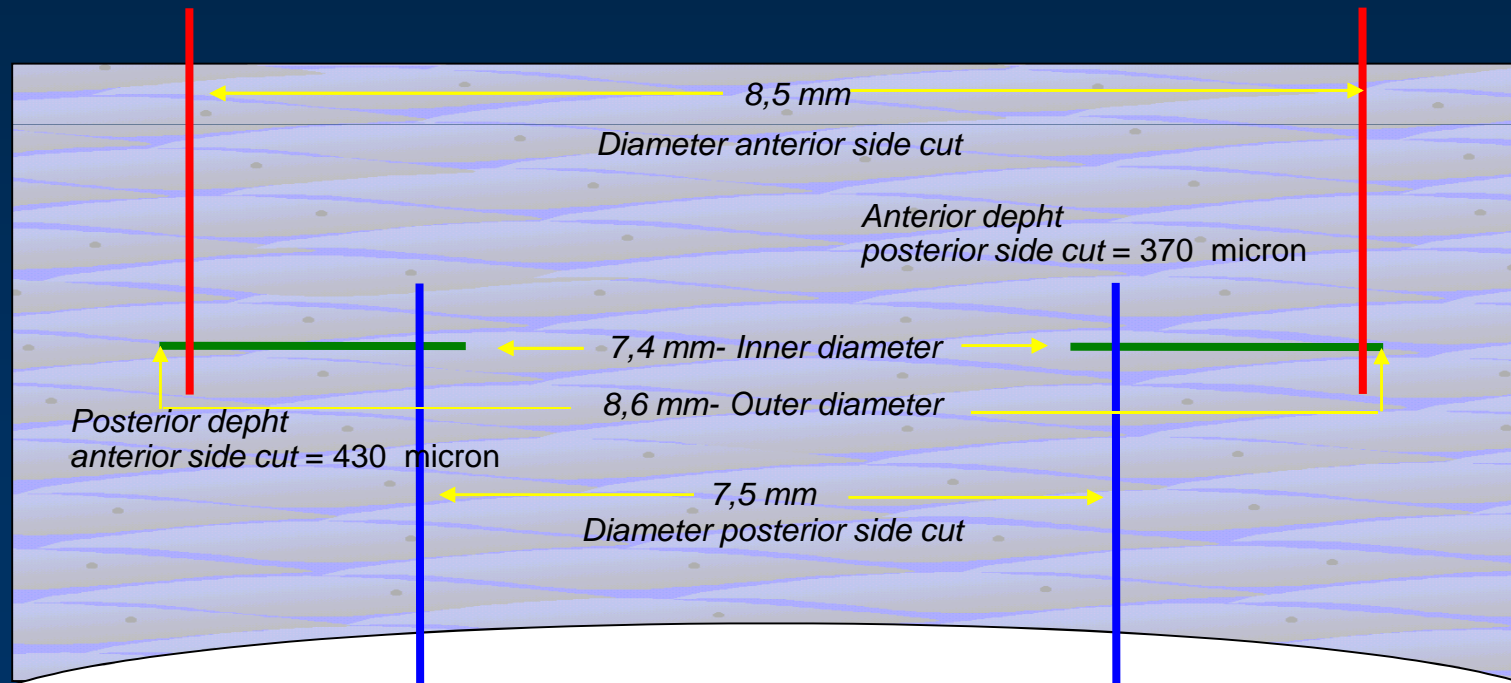


## Mushroom

Ring Lamellar cut = 400  $\mu$ m

Diametro esterno = 8,5 mm

Diametro interno = 7,5 mm

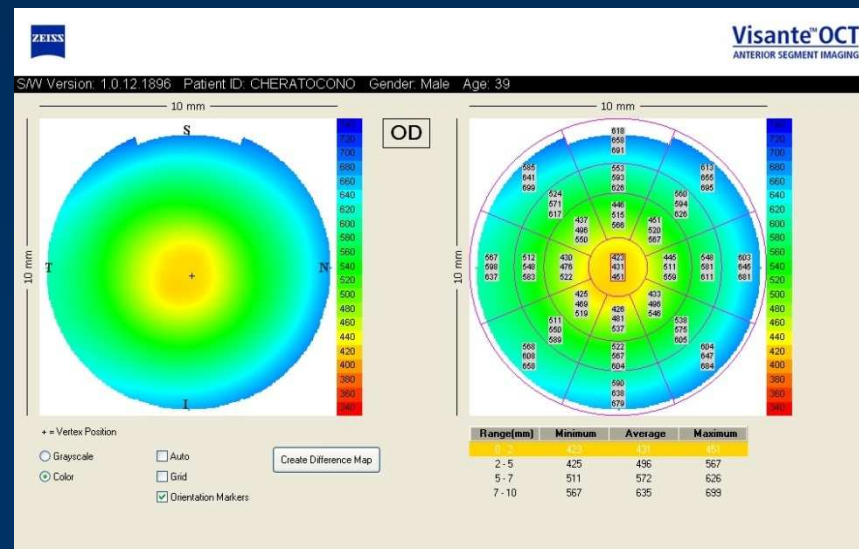


Posterior depth  
posterior side cut = 800 micron



# ➤ leucoma corneale

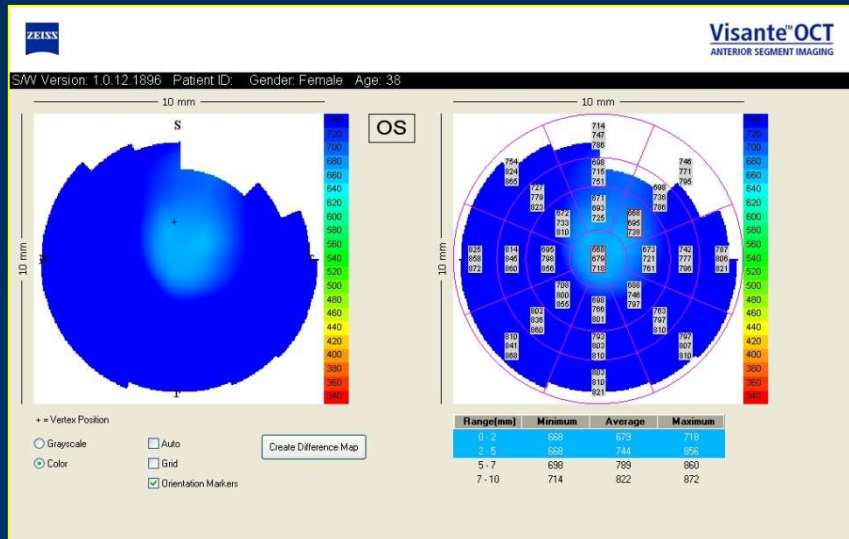
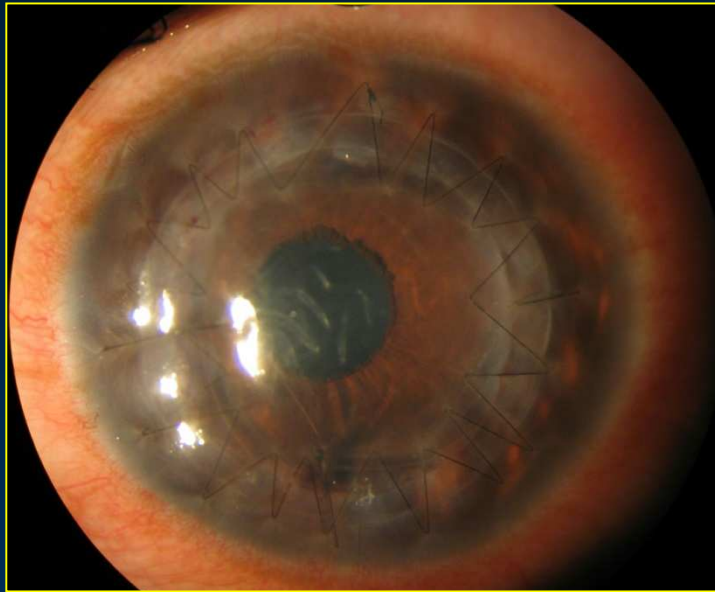
preoperatorio



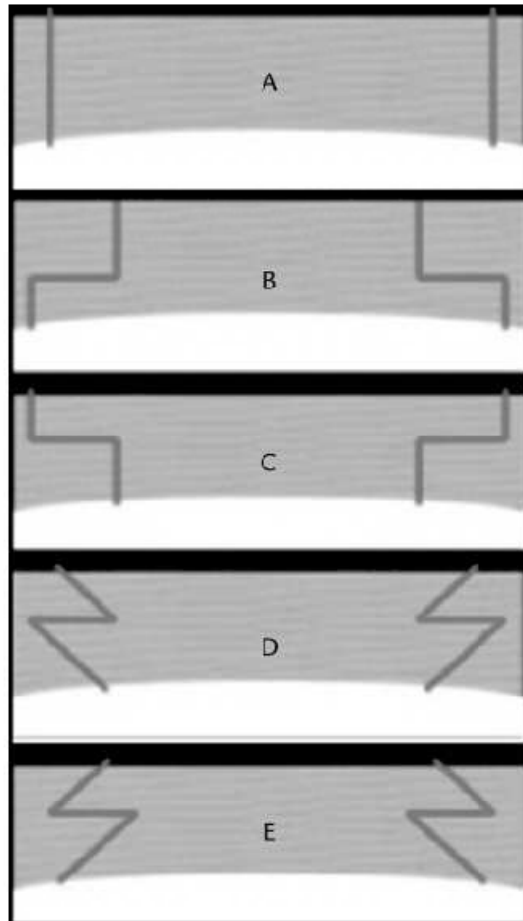




# postoperatorio PK



## STABILITA' BIOMECCANICA CON PROFILI DIFFERENTI



**FIGURE 1.** Illustration of the 5 wound configurations created in this study by the IntraLase-enabled keratoplasty software: traditional, straight vertical cut (A), top hat (B), mushroom (C), zigzag (D), and Christmas tree (E).

**Conclusions:** The femtosecond laser-assisted top hat wound configuration for PK was found to be the most mechanically stable compared with the traditional method and mushroom, zig zag, and Christmas tree configurations.

Femtosecond Laser-assisted Penetrating Keratoplasty  
*Stability Evaluation of Different Wound Configurations*

*Irit Bahar, MD, Igor Kaiserman, MD, MSc, MHA, Penny McAllum, MBChB, FRANZCO,  
and David Rootman, MD, FRCS(C)*

**Cornea • Volume 27, Number 2, February 2008**

## MINORE ASTIGMATISMO

Table 2. Analysis of Astigmatism and Keratometry

	Month 1	Month 3	Month 6	Month 9	Month 12
No. of zig-zag eyes	43	41	26	15	10
No. of conventional eyes	13	14	10	7	5
Average astigmatism					
Zig-zag delta K (SD)	4.5 (2.8)	3.0 (1.8)	2.6 (1.6)	3.0 (1.8)	2.9 (1.0)
Zig-zag range	0.4–13.1	0.2–7.6	0.5–6.0	1.4–5.5	1.5–4.7
Conventional delta K (SD)	6.8 (3.2)	4.5 (2.1)	3.4 (1.5)	4.0 (2.2)	4.3 (1.5)
Conventional range	3.1–13.3	2.0–9.7	0.9–6.3	1.0–8.0	2.3–6.0
P	0.013	0.018	0.17	0.14	0.055
Average keratometry					
Zig-Zag AvK (SD)	42.8 (3.5)	43.0 (3.5)	44.4 (1.9)	44.2 (2.1)	44.9 (2.6)
Zig-Zag range	32.9–47.75	30–50.75	41.35–48.6	41.3–49.65	42.1–50.2
Conventional AvK (SD)	43.1 (3.8)	44.4 (4.7)	45.0 (3.2)	45.1 (3.3)	45.5 (2.5)
Conventional range	34.35–46.8	30.45–51.25	39.55–49.15	40.25–49.05	42.1–48.7
P	0.74	0.21	0.54	0.43	0.72

AvK = average K; K = keratometry; SD = standard deviation.

**Results:** The postoperative follow-up ranged from 1 to 12 months. There was a significant difference in average astigmatism between the groups at postoperative month 1 ( $P = 0.013$ ) and 3 ( $P = 0.018$ ). By month 3, the average astigmatism was 3 diopters (D) in the zig-zag group and 4.46 D in the conventional group. Of the patients with normal macular and optic nerve function ( $n_{ZZ} = 32$ ;  $n_{con} = 14$ ), a significant difference in BSCVA was seen at month 1 ( $P = 0.0003$ ) and month 3 ( $P = 0.006$ ) with 81% of the zig-zag group versus 45% of the conventional group achieving BSCVA of  $\geq 20/40$  by month 3 ( $P = 0.03$ ).

**Conclusions:** The femtosecond laser generated zig-zag-shaped incision results in a more rapid recovery of BSCVA and induces less astigmatism compared with conventional blade trephination PK.

### Comparison of Penetrating Keratoplasty Performed with a Femtosecond Laser Zig-Zag Incision versus Conventional Blade Trephination



# Trapianto di cornea con femtolaser



## AUMENTO DELLA SOPRAVVIVENZA DEL LEMBO

**Methods:** Thirty-two freshly enucleated porcine eyes were divided into 4 equal groups (n = 8): group 1, incomplete penetration using the FS laser (a 100  $\mu$ m-depth from the endothelial side remained); group 2, complete penetration using the FS; group 3, trephination using a vacuum trephine until the aqueous humor appeared; group 4, no treatment (control group). For groups 1 and 2, side cuts were

**TABLE 1.** The Mean Proportion of Endothelial Cell Loss At the Center of the Graft in Each Group

	Endothelial Cell Loss (%)
Group 1 (n = 8)	5.38 $\pm$ 3.21
Group 2 (n = 8)	4.80 $\pm$ 2.22
Group 3 (n = 8)	6.21 $\pm$ 3.43
Control (n = 8)	5.82 $\pm$ 4.22

*P* = 0.15, nonparametric method of Kruskal-Wallis.

**Conclusions:** FS laser use is safe for the endothelium at the graft center and has less harmful effects on the endothelium at the incision area than does conventional trephination. Therefore, FS laser-assisted corneal grafts with complete penetration seems to be the optimum choice for preserving endothelial cells during PK.

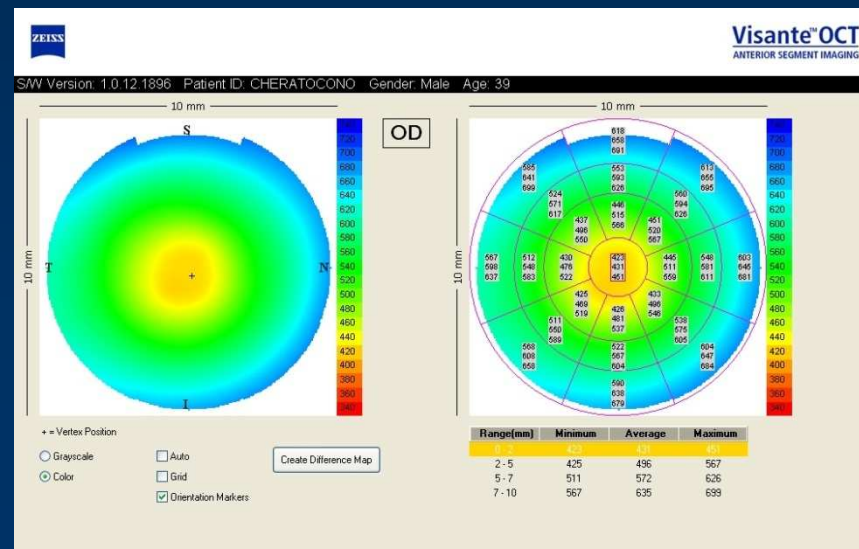
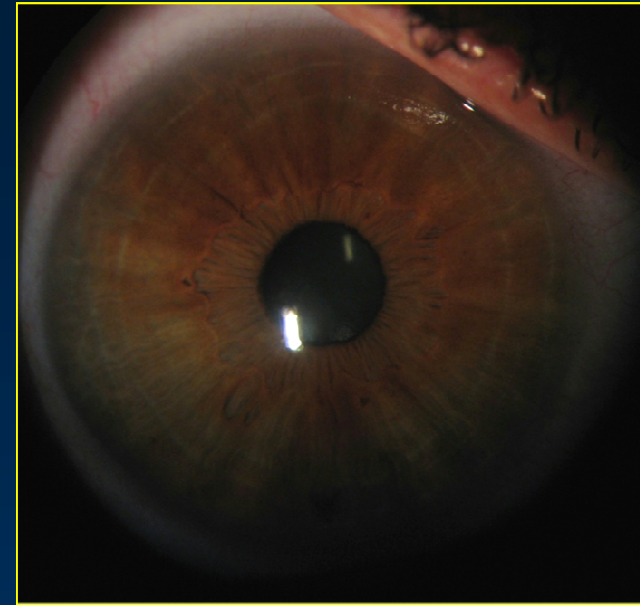
The Comparison of Femtosecond Laser-Assisted Penetrating Keratoplasty With Conventional Surgery in Terms of Endothelial Safety: Ex Vivo Study Using Porcine Eyes

*Jin-Hyoung Kim, Suk-Kyue Choi, and Doh Lee*

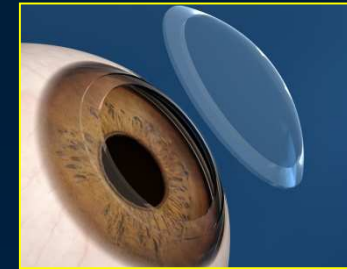
(*Cornea* 2009;28:812–816)

# ➤ Cheratocono III stadio

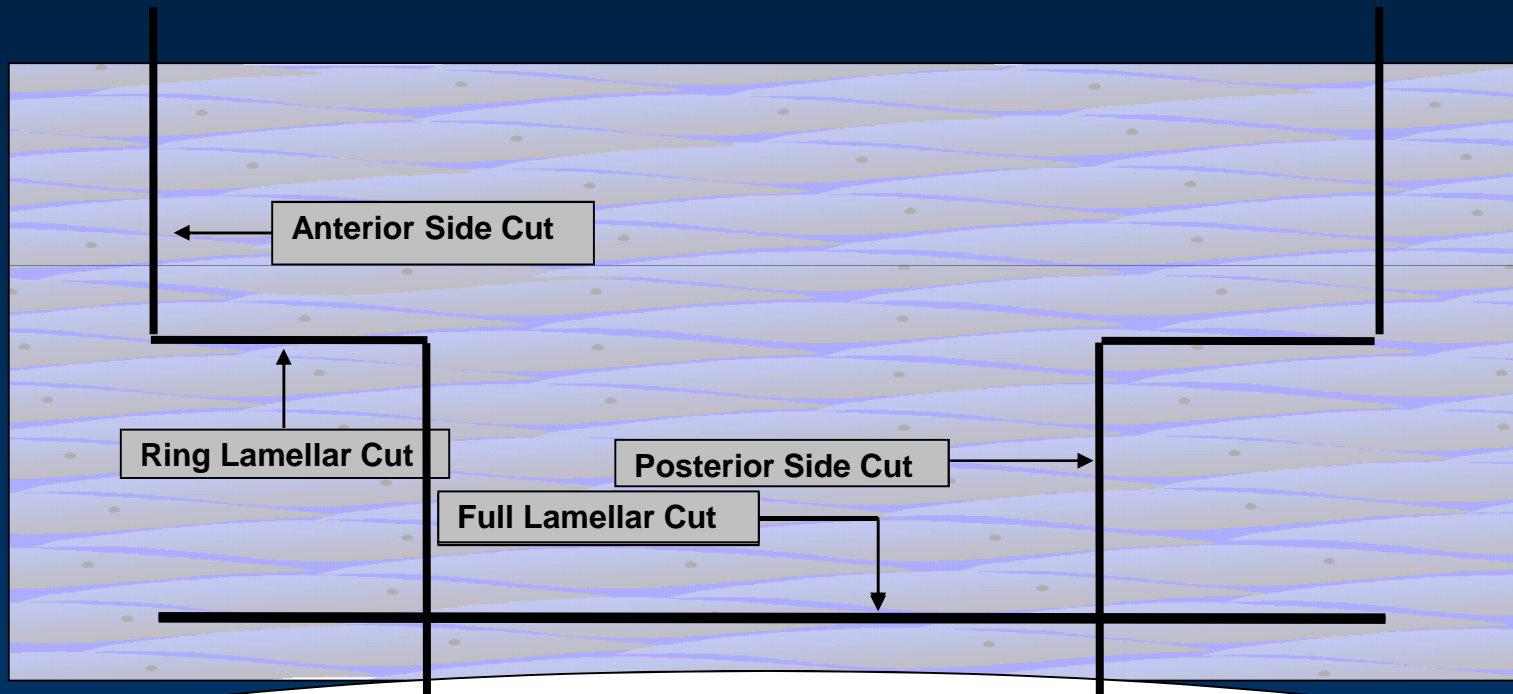
preoperatorio

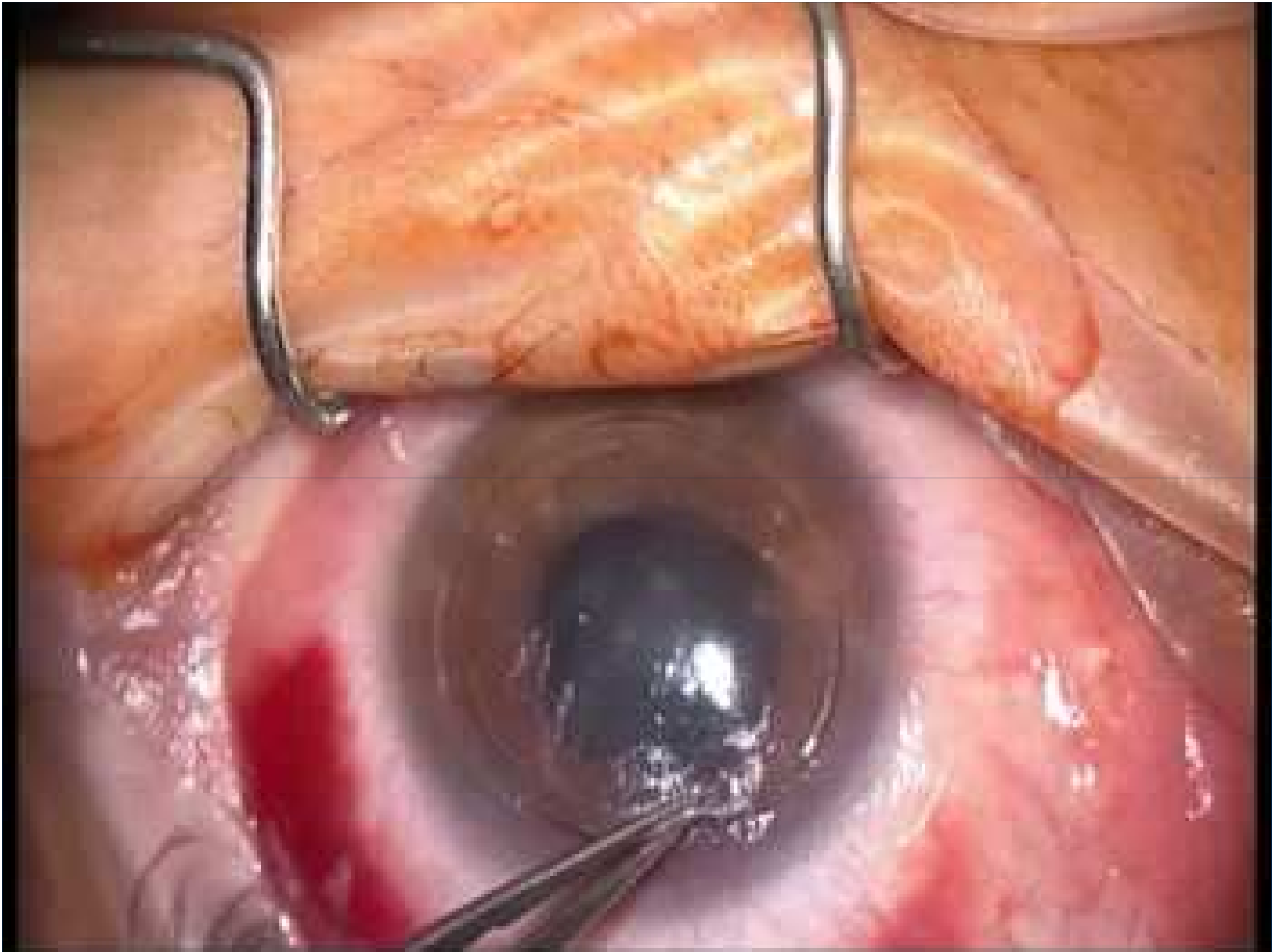


# IEK

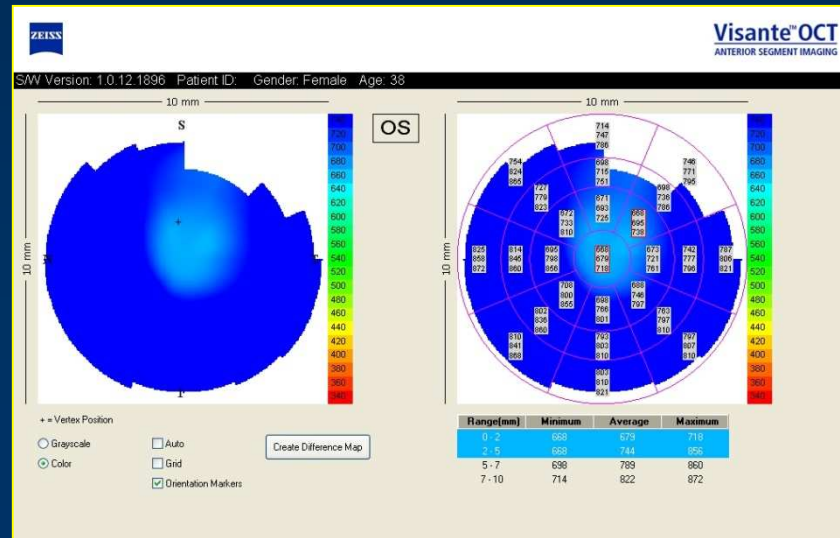
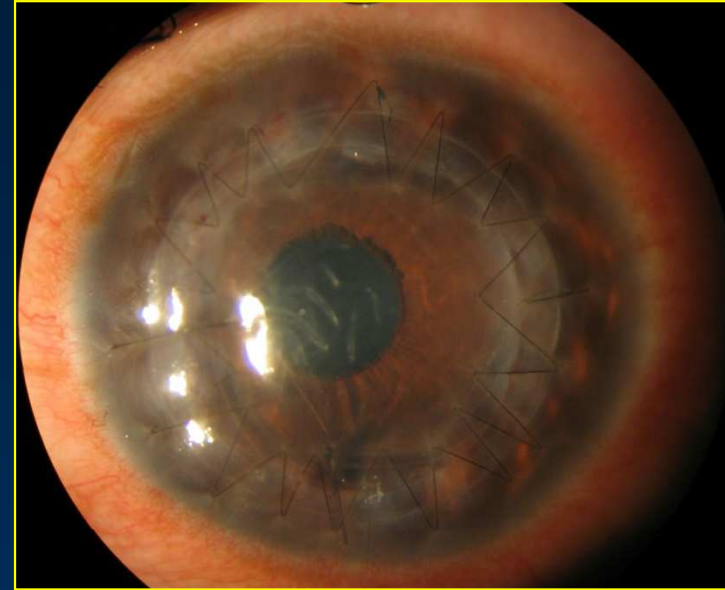


## LK (Mushroom)





# postoperatorio LK





# Non meccanizzata (Femtolasere) *versus* manuale

*Microkeratome versus Femtosecond Laser Predissection of Corneal grafts for Anterior and Posterior Lamellar Keratoplasty*

*Suwan-apichon O et al. Cornea 2006*

*Deep anterior lamellar keratoplasty performed with the femtosecond laser zigzag incision for the treatment of stromal corneal pathology and ectatic disease*

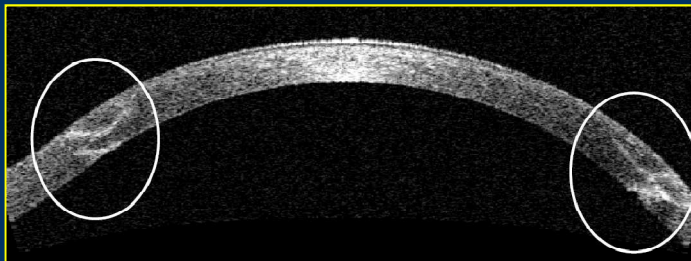
*Farid M et al. J C R S 2009*

*Femtosecond laser-assisted sutureless anterior lamellar keratoplasty*

*Yoo SH et al. Ophthal 2008*

## FEMTO

- Perfetto incastro donatore/ricevente
- Minore induzione di astigmatismo
- Precoce rimozione sutura
- Possibilità senza sutura
- Più rapido recupero visivo
- Alterazioni ottiche interfaccia donatore/ricevente



## MANUALE

- Ottima interfaccia donatore/ricevente
- Necessario training chirurgo





# Conclusioni

- training chirurgico breve
- chirurgia più standardizzabile con predicibilità del risultato anatomico
- > sicurezza nella trapanazione del letto ricevente (spessori non uniformi)
- interfaccia ricevente/donatore ancora migliore con la manuale
- valutazione dei risultati con il Femtolaser 150 KHz
- l'avvento del femtolaser ha permesso al trapianto corneale maggiore precisione con risultati refrattivi paralleli a quelli della chirurgia refrattiva

# Prospettive

- numerose possibilità di forme geometriche per ottimizzare l'incastro donatore/ricevente
- minima sutura
- colle corneali
- rapida riabilitazione
- elevata qualità di acuità visiva





GRAZIE PER L'ATTENZIONE