

# ICL

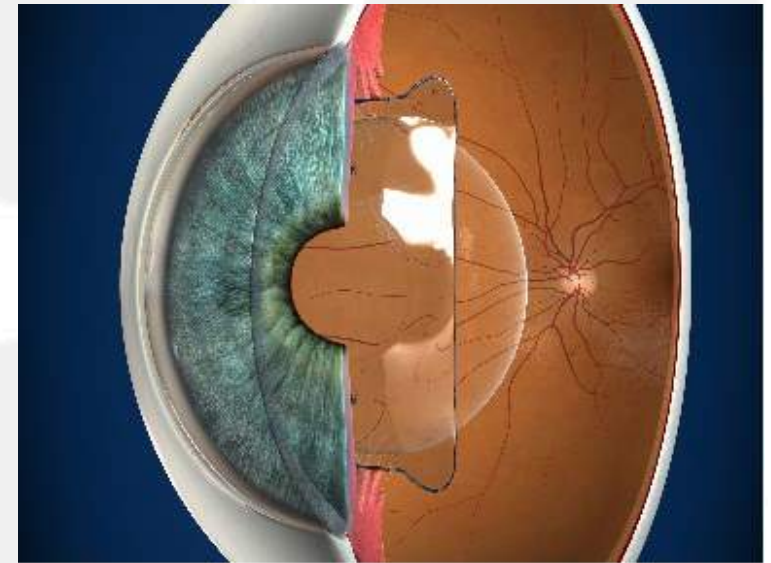
Giacomo Savini

Studio Oculistico d'Azeglio – Bologna  
Fondazione GB Bietti IRCCS – Roma



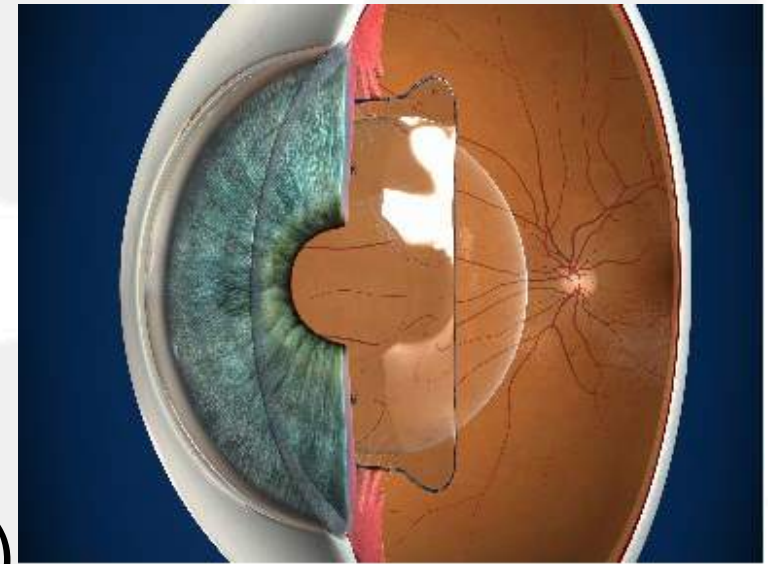
# ICL

- Introduzione
- Esami preoperatori
- Sizing
- Tecnica chirurgica
- Confronto con LASIK
- Complicanze

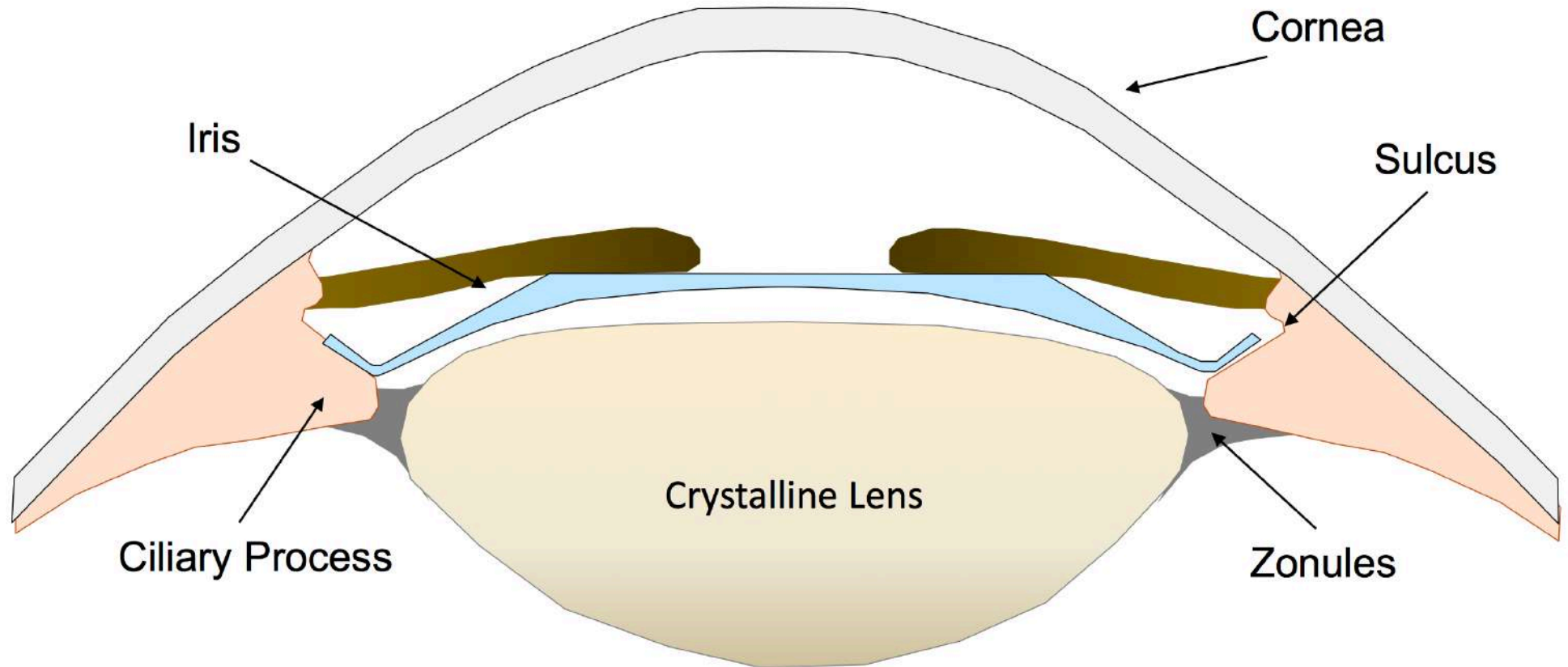


# ICL

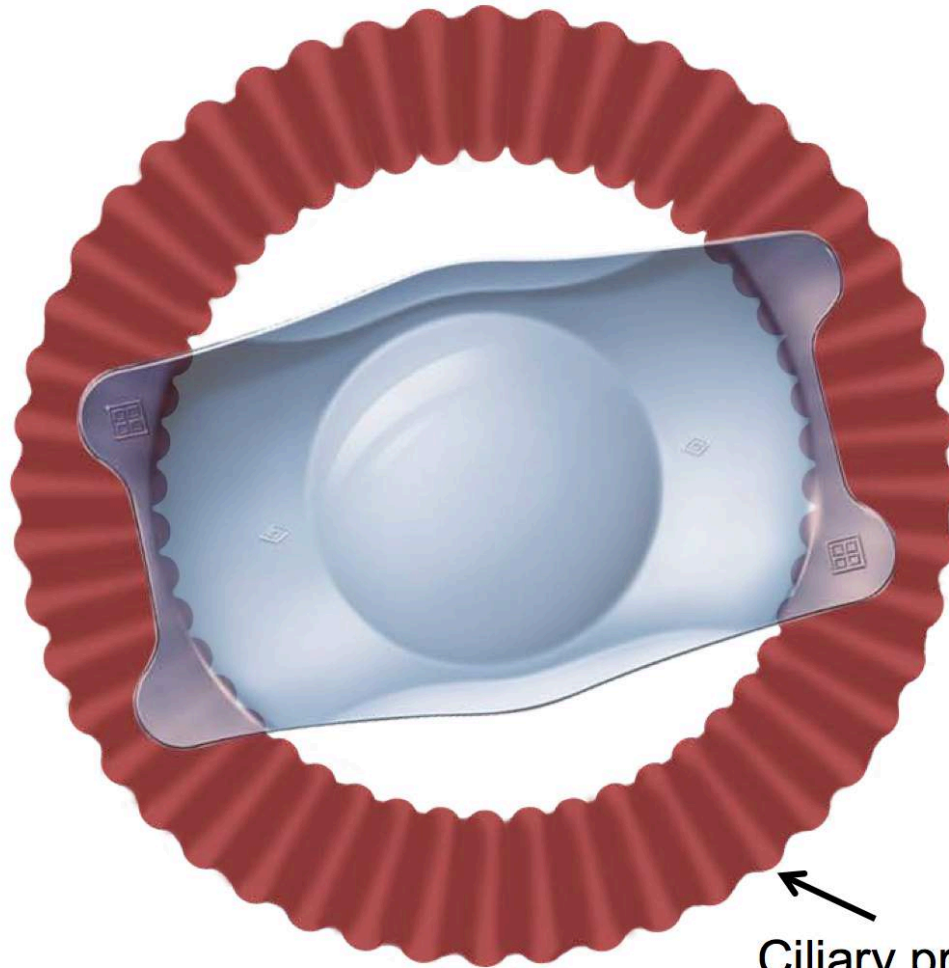
- IOL fuchica pieghevole
- Collamero (= collagene + copolimero): materiale idrofilico (copolimero di idrossietilmetacrilato (60%) e collagene porcino) con cromoforo che assorbe UV
- Plate-haptic design



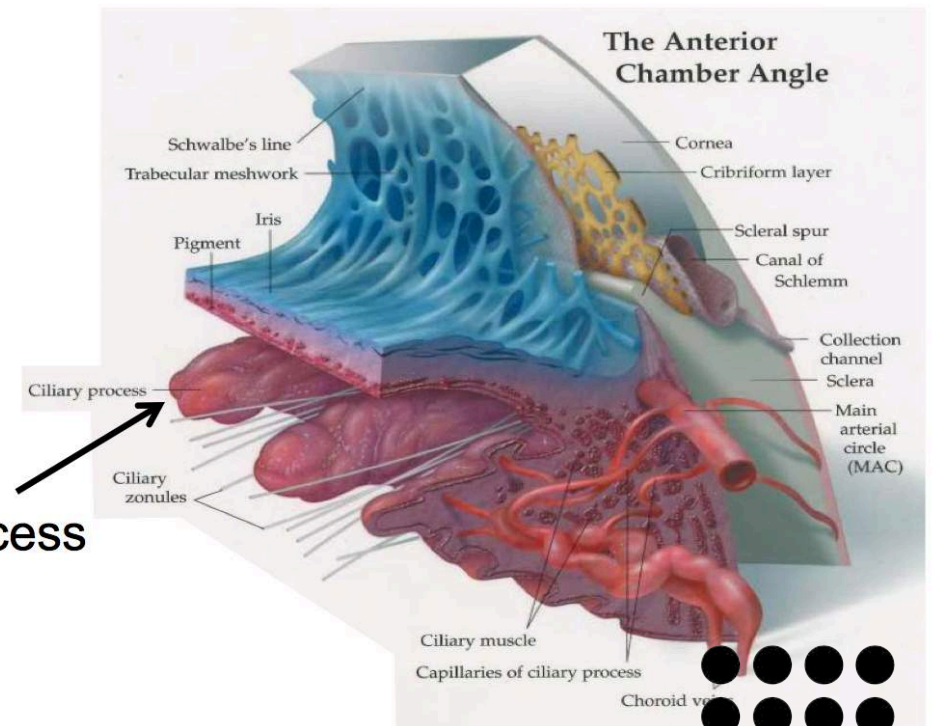
# ICL



# ICL

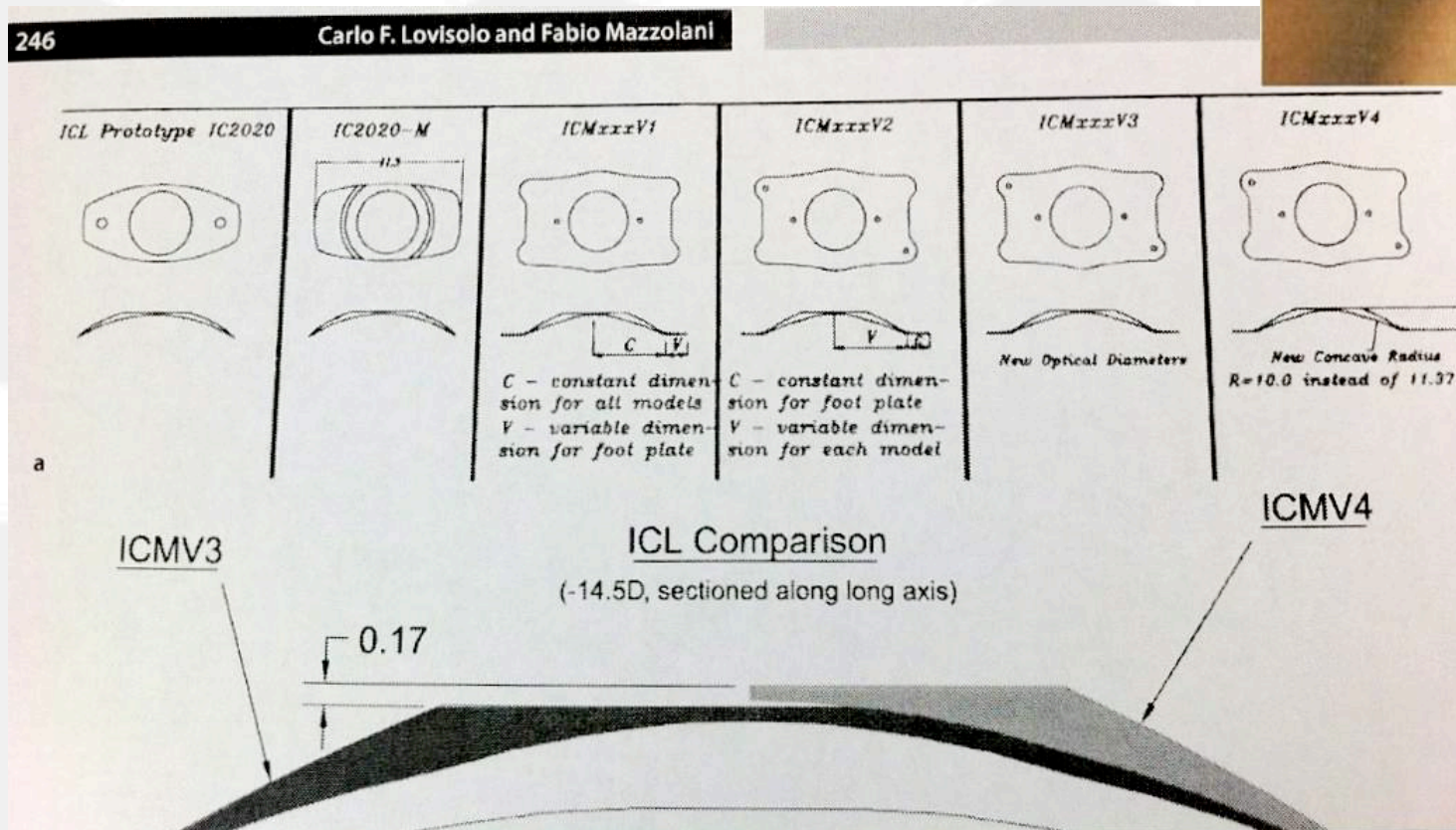
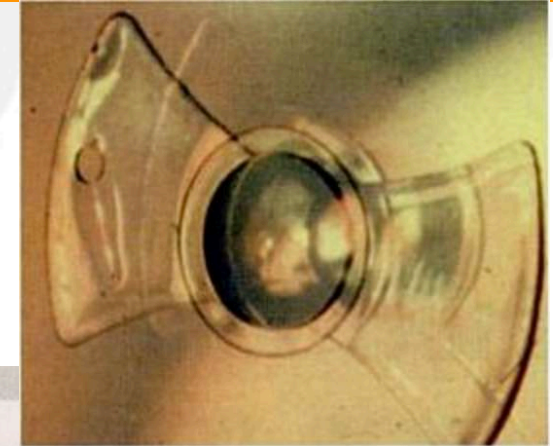


**The footplates of the Visian ICL are designed to find a fixation point among the ridges created by the ciliary processes, which form the pars plicata**



# EVOLUZIONE

Le lenti fachiche da c.p. sono state ideate da Fyodorov nel 1986  
Primo impianto: 1993



# EVOLUZIONE

V1: primo modello

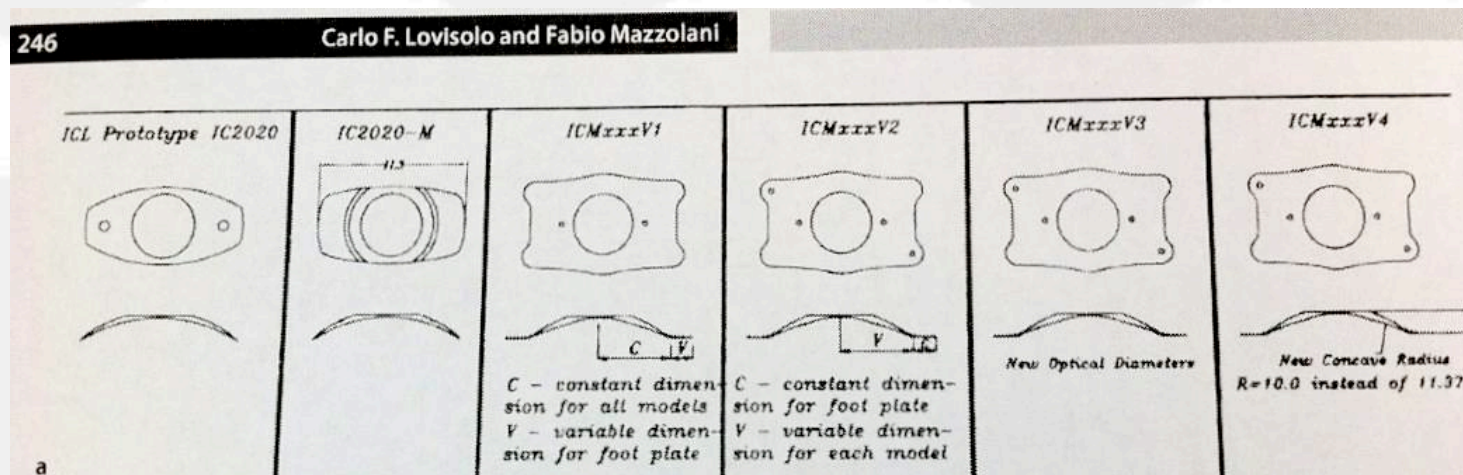
V2: lunghezza variabile della lente

V3: aumento dimensioni ottica

V4: aumento vaulting

V4b: conservazione in liquido (BSS)

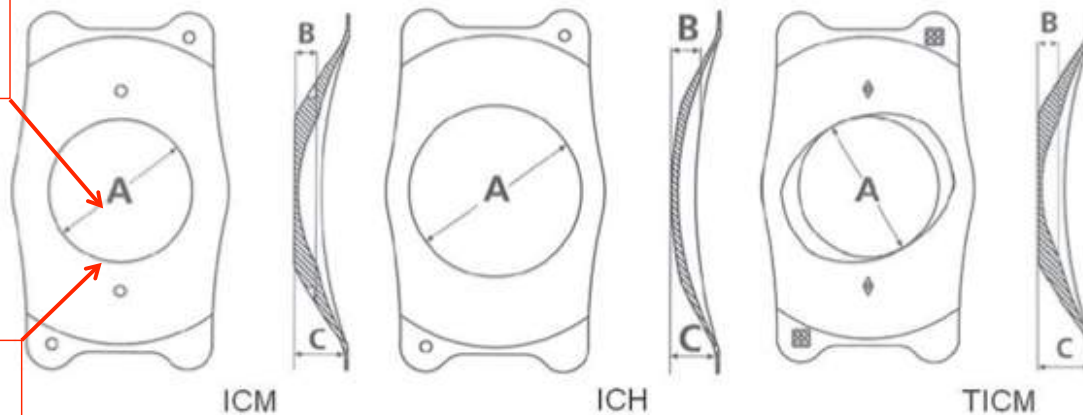
V4c: foro centrale (CentraFLOW™)



# Modelli ICL

Spessore ottica al centro: 50  $\mu\text{m}$

Massimo spessore alla giunzione fra ottica ed ansa: 300-700  $\mu\text{m}$



Sezioni frontale e laterale degli ultimi modelli di ICL per miopia (ICMV4), ipermetropia (ICHV3) e astigmatismo (TICMV4)



# Modelli ICL

ICL ICMV4 (miopia) e TICMV4 (astigmatismo) sono disponibili in 4 lunghezze (12.1, 12.6, 13.2 e 13.7 mm) e con diametro della zona ottica variabile tra 4.65 e 5.5 mm in base al potere diottrico

ICL ICHV3 (ipermetropia) ha anch'essa 4 lunghezze disponibili (11.6, 12.1, 12.6 e 13.2 mm) e un diametro della zona ottica di 5.5 mm

# Modelli ICL

**Table 1: Characteristics of the currently available Myopic (V4), Hyperopic (V3) and Toric ICL™ (V4) models**

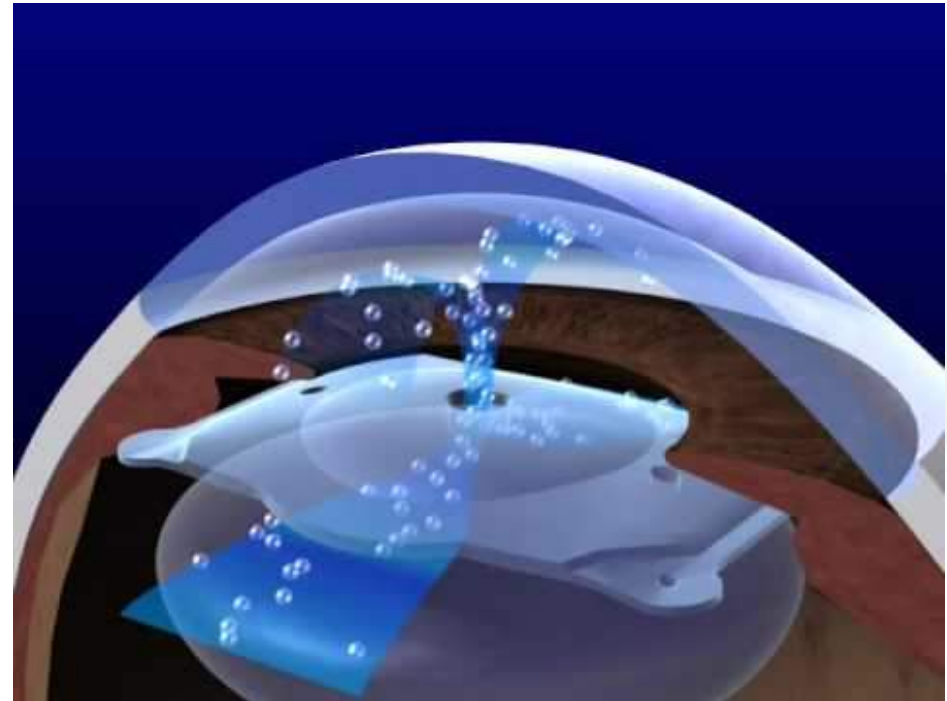
ICL™	Spherical Power	Cylindrical Power	Optical Diameter	Optic / Haptic Thickness	Overall Height
Myopic model (V4)	-3.0 to -12.0 D	0.0	5.50 mm	0.3 to 0.5 mm	1.15 to 1.77 mm
	-12.5 to -13.5 D	0.0	5.25 mm	0.5 mm	1.08 to 1.78 mm
	-14.0 to -16.5 D	0.0	5.00 mm	0.5 to 0.6 mm	1.12 to 1.89 mm
	-17.0 to -23.0 D	0.0	4.65 mm	0.5 to 0.7 mm	1.19 to 2.05 mm
Hyperopic model (V3)	+3.0 to +12.0 D	0.0	5.50 mm	0.2 mm	1.25 to 2.29 mm
	+12.5 to +13.5 D	0.0	5.50 mm	0.2 mm	1.61 to 2.36 mm
	+14.0 to +16.5 D	0.0	5.50 mm	0.2 mm	1.68 to 2.49 mm
	+17.0 to +21.5 D	0.0	5.50 mm	0.2 mm	1.82 to 2.79 mm
Toric model (V4)	-3.0 to -12.0 D	+1.0 to +6.0 D	5.50 mm	0.3 to 0.5 mm	1.5 mm
	-12.5 to -13.5 D	+1.0 to +6.0 D	5.25 mm	0.5 mm	1.5 mm
	-14.0 to -16.5 D	+1.0 to +6.0 D	5.00 mm	0.5 to 0.6 mm	1.5 to 1.6 mm
	-17.0 to -23.0 D	+1.0 to +6.0 D	4.65 mm	0.5 to 0.7 mm	1.6 to 1.7 mm

- ✓ Miopia: da -3 a -23 D (-18 sugli occhiali)
- ✓ Astigmatismo: da 0 a 6 D
- ✓ Ipermetropia: da 0 a 10 D

# ICL

V4c

- CentraFLOW™
- Foro centrale di 360 micron
- Flusso naturale dell'acqueo senza necessità di iridotomia



# ICL



# INDICAZIONI

# INDICAZIONI

- ✓ Miopia elevata (oltre 7-9 D): LASIK non possibile per rischio ectasia e scarsa qualità visiva
- ✓ Non esiste un chiaro cutoff. Ma è stato dimostrato che le ICL offrono una migliore qualità visiva rispetto alla LASIK, per cui tendiamo ad offrire le ICL oltre le 7 diottrie (anche se non ci sono controindicazioni alla LASIK)

# INDICAZIONI

- ✓ Miopia bassa con controindicazioni alla LASIK
  - Cheratocono frusto o sospetto
  - Residual bed thickness  $<300 \mu\text{m}$
  - Percent tissue altered  $>40\%$
  - Potere corneale previsto  $<35 \text{ D}$
- ✓ Cheratocono stabile
- ✓ Errori refrattivi residui dopo LASIK, trapianto di cornea, impianto di anelli per cheratocono, CXL e pseudofachia

# ESAMI PREOPERATORI



# VALUTAZIONE DELLA REFRAZIONE

- ✓ Miopia fino a 6D: refrazione manifesta
- ✓ Miopia maggiore di 6D: refrazione con LAC
- ✓ Ipermetropia: consigliata cicloplegia soprattutto in soggetti giovani (accomodazione)

# VALUTAZIONE DELLA REFRAZIONE

- ✓ E' importante misurare il visus con LAC perche' in questo modo viene annullata la distanza vertice corneale-occhiali
- ✓ Esempio:
  - ✓ Lente su occhiali di prova -15 D
  - ✓ Potere sul piano corneale se la lente è a 10 mm dalla cornea = -13.04 D
  - ✓ Potere sul piano corneale se la lente è a 15 mm dalla cornea = -12.24 D

# ESAMI PREOPERATORI

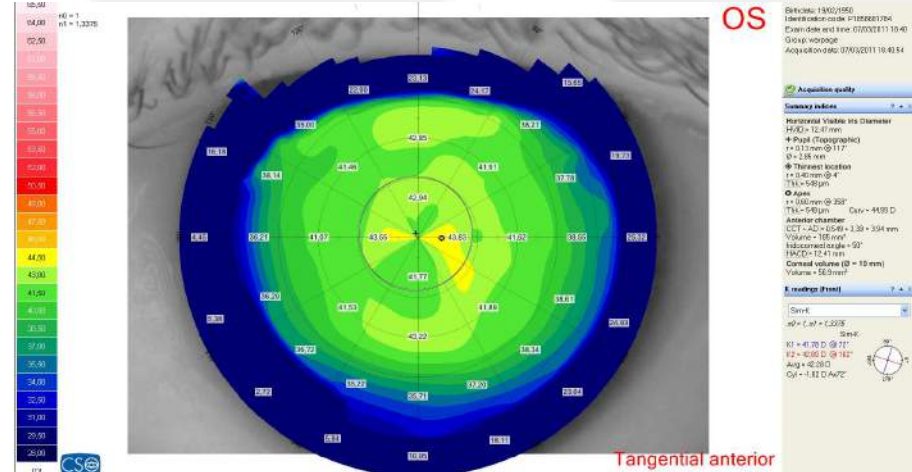
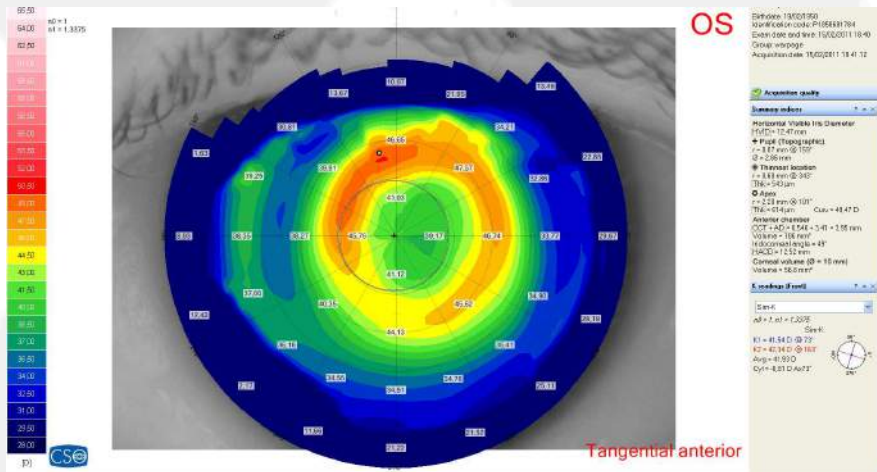
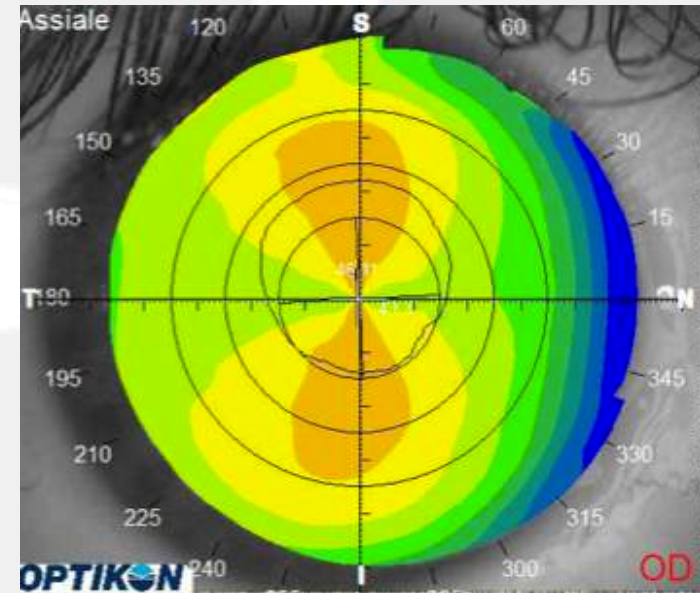
E' necessario eseguire alcuni esami preoperatori per valutare se il paziente é idoneo all'impianto di una lente ICL:

- ✓ Topografia corneale
- ✓ Scheimpflug camera
- ✓ (IOLMaster)
- ✓ Conta endoteliale
- ✓ Pupillometria
- ✓ UBM

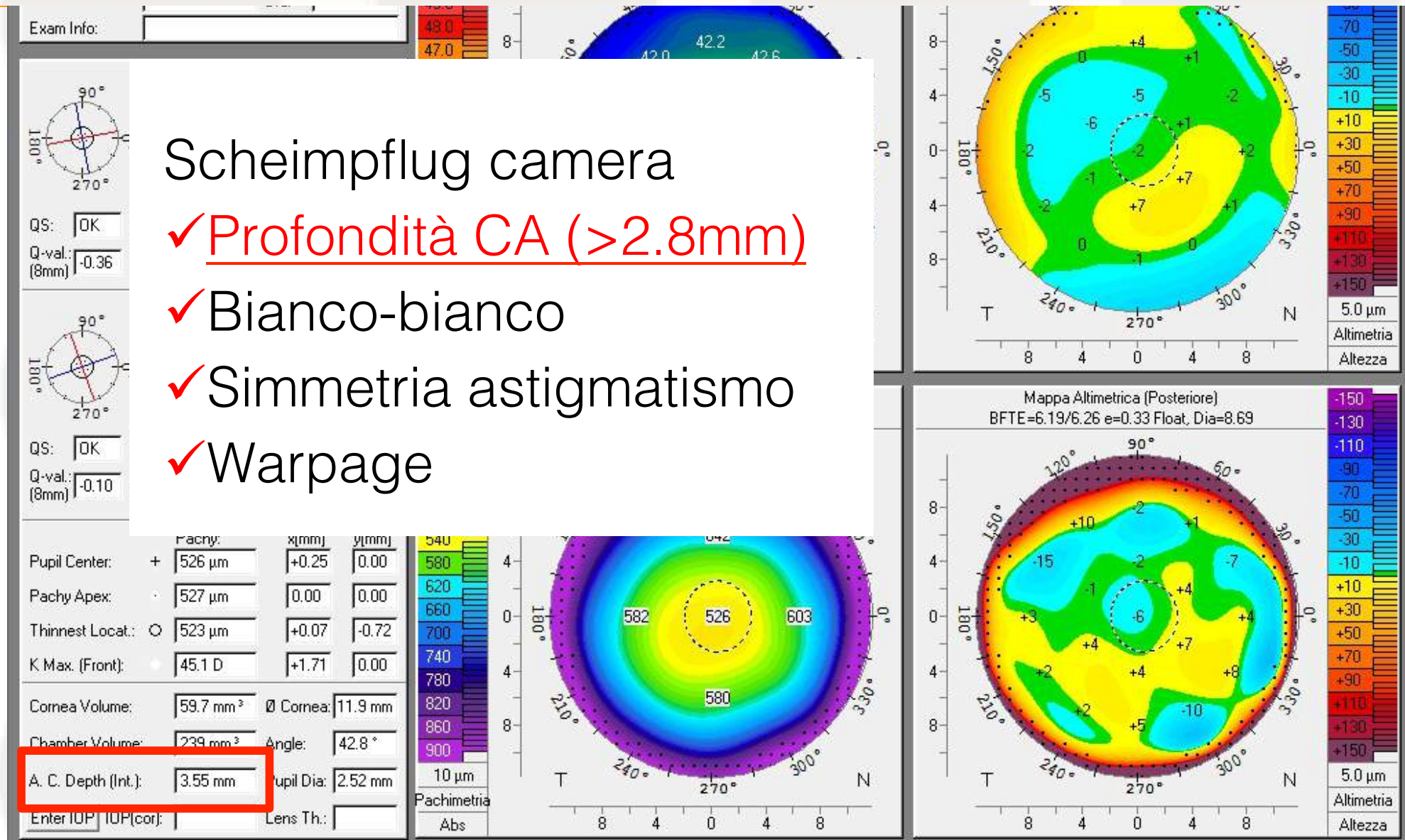
# ESAMI PREOPERATORI

Topografia corneale

- ✓ Bianco-bianco
- ✓ Simmetria astigmatismo
- ✓ Warpage



# ESAMI PREOPERATORI



Scheimpflug camera

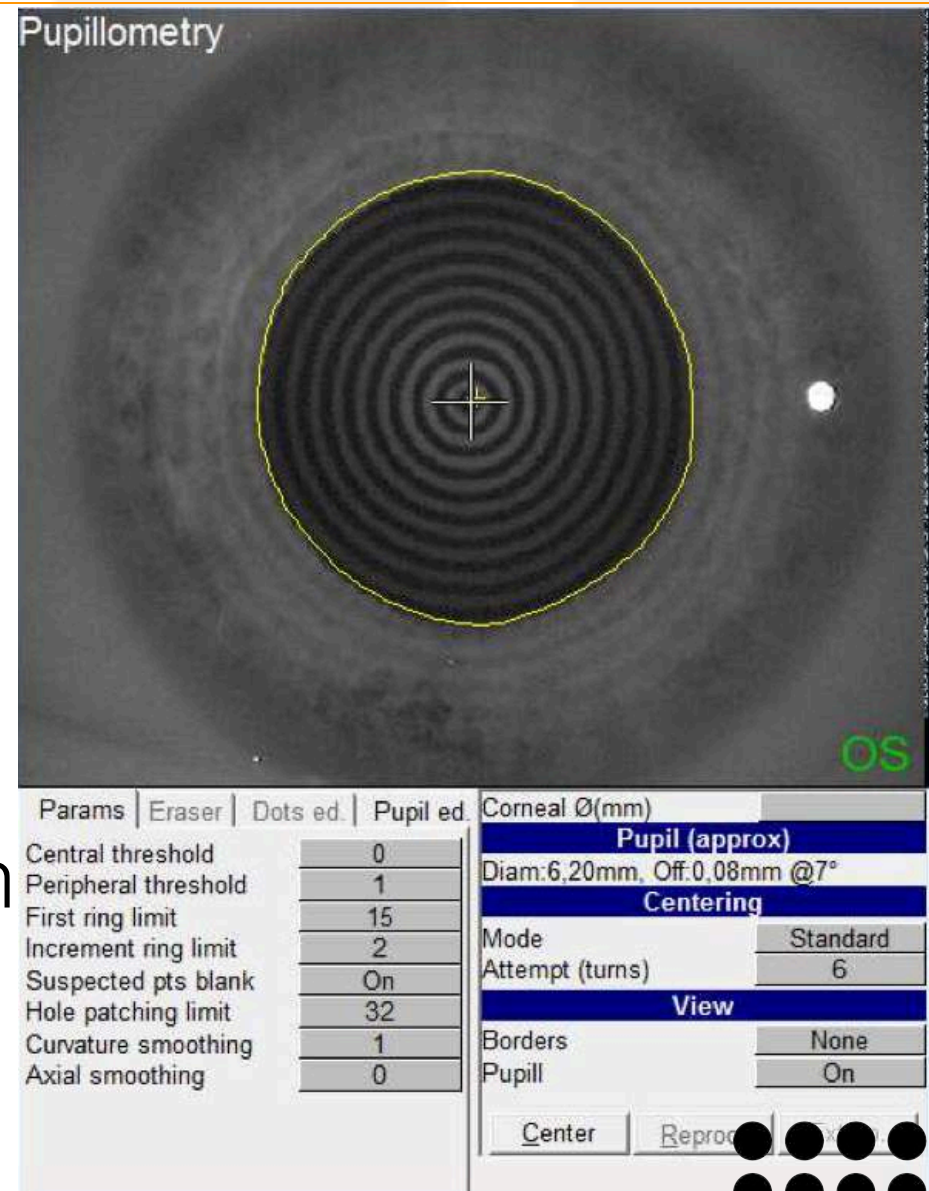
- ✓ Profondità CA (>2.8mm)
- ✓ Bianco-bianco
- ✓ Simmetria astigmatismo
- ✓ Warpage

# ESAMI PREOPERATORI

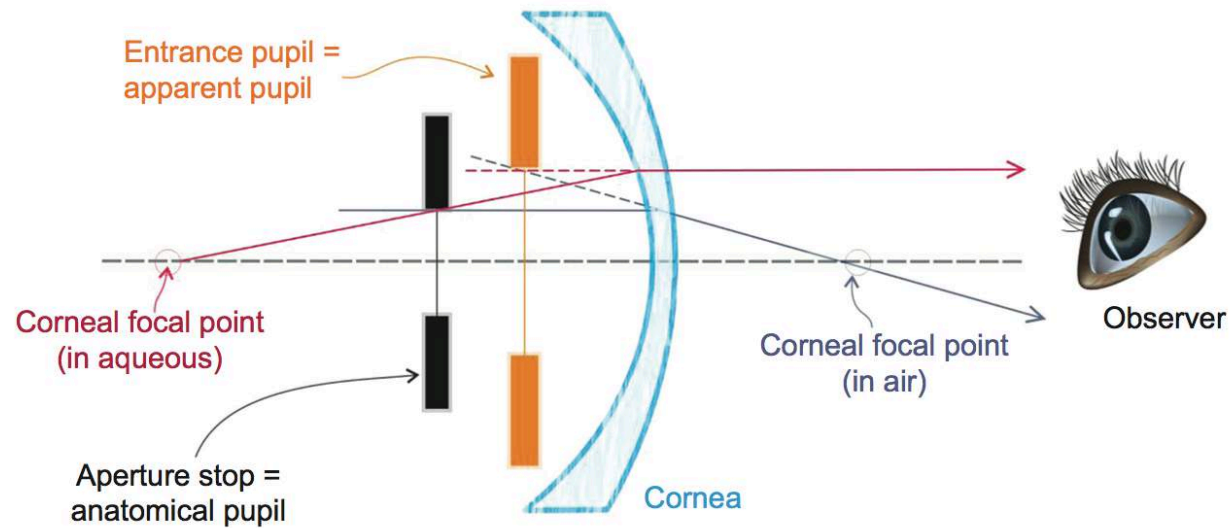
- ✓ Conta cellule endoteliali ( $>2000$  cell/mm<sup>2</sup>)
- ✓ Pupillometria
  - ✓ Il diametro pupillare (scotopico) deve essere inferiore al diametro dell'ottica

# PUPILLA FISICA E PUPILLA D'ENTRATA

- Pupilla fisica = diametro reale
- Pupilla d'entrata = diametro misurato attraverso la cornea e la camera anteriore, che ne determinano un ingrandimento



# PUPILLA FISICA E PUPILLA D'ENTRATA



Kanellopoulos et al. Clin Ophthalmol 2014



# PUPILLA FISICA E PUPILLA D'ENTRATA

E' possibile calcolare la pupilla fisica a partire da quella d'entrata?

● Pupilla fisica = pupilla d'entrata x  $(1 - ACD \times K / 1,3375)$

## Pupil size and the ablation zone in laser refractive surgery: Considerations based on geometric optics

Kenn A. Freedman, MD, PhD, Sandra M. Brown, MD, Steven M. Mathews, OD, PhD, Rockefeller S.L. Young, PhD

**Purpose:** To determine whether the currently accepted method of selecting a minimum ablation zone size for refractive surgery based on dark-adapted pupil diameter is substantiated by geometric optical analysis.

**Setting:** Department of Ophthalmology and Visual Sciences, Texas Tech University Health Sciences Center, Lubbock, Texas, USA.

**Methods:** An optical model of the anterior segment was developed to calculate the effective corneal refractive diameter (ECRD), which is the diameter of the area of cornea that refracts all incident light rays arising from objects along the line of sight through the physical pupil (PP). The concept of the entrance pupil (EP) was reexamined and developed, and the ECRD was calculated over a range of corneal curvatures (K), anterior chamber depths (ACDs), and EP sizes. The model was generalized to include oblique light rays. Calculations were performed using MatLab Optimization Toolbox® software (The MathWorks).

**Results:** For a given EP size, the ECRD was significantly influenced by K and slightly influenced by ACD. For objects on the line of sight, the ECRD was smaller than the EP in all cases. Regarding rays from objects in the periphery, the ECRD expanded rapidly as the angle of oblique incidence increased.

**Conclusions:** For objects on the line of sight, the ECRD is always smaller than the clinically measured pupil (EP) because the EP is substantially magnified relative to the PP. Ablation zones larger than the EP should, in theory, prevent scattered or defocused light rays from contributing to the foveal image. When considering objects in the periphery, the increase in ECRD is sufficiently rapid that current refractive procedures cannot stop scattered light from these objects from contributing to the retinal image.

*J Cataract Refract Surg* 2003; 29:1924-1931 © 2003 ASCRS and ESCRS

# PUPILLA FISICA E PUPILLA D'ENTRATA

## Esempio

- Pupilla d'entrata = 5mm
- $K = 44 \text{ D}$
- ACD = 4 mm
- Pupilla fisica = 4,37 mm
  
- Ingrandimento = 14%

# PUPILLA FISICA E PUPILLA D'ENTRATA

## Importanza della pupilla fisica

- Procedure effettuate sul piano irideo
- Impianto lenti intraoculari (fachiche e pseudofachiche)
- Non è un dato rilevante per LASIK e PRK

# PUPILLA FISICA E PUPILLA D'ENTRATA

ICL™	Spherical Power	Optical Diameter	Entrance Pupil
Myopic model (V4)	-3.0 to -12.0 D	5.50 mm	6.25 mm
	-12.5 to -13.5 D	5.25 mm	6 mm
	-14.0 to -16.5 D	5.00 mm	5.7 mm
	-17.0 to -23.0 D	4.65 mm	5.3 mm
Hyperopic model (V3)	+3.0 to +12.0 D	5.50 mm	6.25 mm
	+12.5 to +13.5 D	5.50 mm	
	+14.0 to +16.5 D	5.50 mm	
	+17.0 to +21.5 D	5.50 mm	
Toric model (V4)	-3.0 to -12.0 D	5.50 mm	6.25 mm
	-12.5 to -13.5 D	5.25 mm	6 mm
	-14.0 to -16.5 D	5.00 mm	5.7 mm
	-17.0 to -23.0 D	4.65 mm	5.3 mm

# ESAMI PREOPERATORI

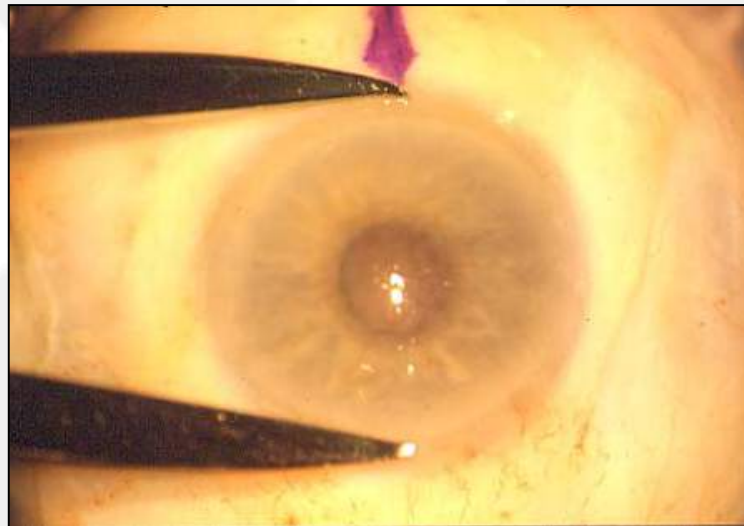
✓ Bianco-bianco (white-to-white, WTW)

✓ UBM

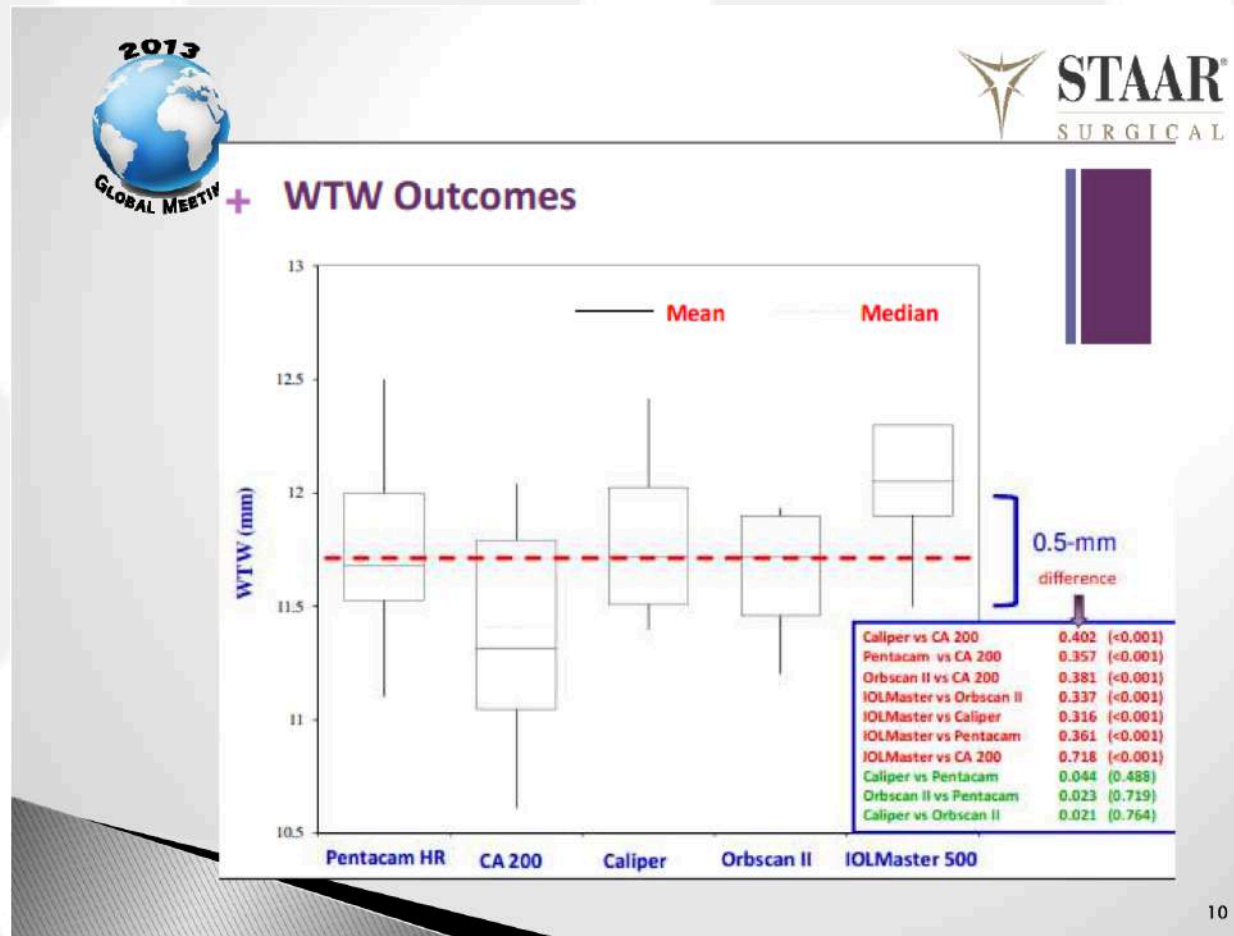
# CALCOLO DELLALENTE

Il diametro della lente viene calcolato prendendo in considerazione:

- ✓ White-to-white orizzontale
- ✓ Profondita' della camera anteriore (ACD)



# CALCOLO DELLA LENTE



Orbscan II e Pentacam HR sono i due strumenti che danno misurazioni più simili al compasso manuale

# CALCOLO DELLALENTE

- ✓ Metodo iniziale per calcolare lunghezza ICL:<sup>1</sup>
  - ✓ Occhi miopi:  $WTW - 0.5 \text{ mm}$
  - ✓ Occhi ipermetropi:  $WTW + 0.5 \text{ mm}$
  
- ✓ Metodo successivo:<sup>2</sup>
  - ✓ Occhi miopi (ACD  $< 3.5 \text{ mm}$ ):  $WTW + 0.5 \text{ mm}$
  - ✓ Occhi miopi (ACD  $> 3.5 \text{ mm}$ ):  $WTW + 1.0 \text{ mm}$
  
- ✓ Metodo FDA:
  - ✓ Occhi miopi (ACD  $< 3.5 \text{ mm}$ ):  $WTW + 1.1 \text{ mm}$
  - ✓ Occhi miopi (ACD  $> 3.5 \text{ mm}$ ):  $WTW + 1.6 \text{ mm}$
  
- ✓ Metodo attuale (calcolatore Staar)
  - ✓ Occhi miopi: aggiungere  $0.6-1.5 \text{ mm}$
  - ✓ Occhi ipermetropi: aggiungere  $0.5-1.0 \text{ mm}$

1 – Rosen E, et al. Staar Collamer posterior chamber phakic intraocular lens to correct myopia and hyperopia. JCRS 1998;24:596-606

2 – Choi KH, et al. Ultrasound biomicroscopy for determining Visian implantable collamer contact lens length in phakic IOL implantation. J Refract Surg 2007;23:362-367



WTW (mm)	Lunghezza ICL miopica (mm)	Differenza (mm)	Lunghezza ICL ipermetropica (mm)	Differenza (mm)
10.7	12.1	1.4	-	
10.8	12.1	1.3	-	
10.9	12.1	1.2	11.6	
11	12.1	1.1	11.6	0.6
11.1	12.1	1	11.6	0.5
11.2	12.6	1.4	12.1	0.9
11.3	12.6	1.3	12.1	0.8
11.4	12.6	1.2	12.1	0.7
11.5	12.6	1.1	12.1	0.6
11.6	12.6	1	12.1	0.5
11.7	12.6 (13.2 con ACD >2.9)	0.9 (1.5)	12.6	0.9
11.8	12.6 (13.2 con ACD >2.9)	0.8 (1.4)	12.6	0.8
11.9	13.2	1.3	12.6	0.7
12	13.2	1.2	12.6	0.6
12.1	13.2	1.1	12.6	0.5
12.2	13.2	1	13.2	1
12.3	13.2	0.9	13.2	0.9
12.4	13.2 (13.7 con ACD>3.1)	0.8 (1.3)	13.2	0.8
12.5	13.2 (13.7 con ACD>3.1)	0.7 (1.2)	13.2	0.7
12.6	13.2 (13.7 con ACD>3.1)	0.6 (1.1)	13.2	0.6
12.7	13.7	1	-	
12.8	13.7	0.9	-	
12.9	13.7	0.8	-	

# CALCOLO DELLA LENTE

- ✓ Il bianco-bianco non corrisponde e non è correlato alla distanza solco-solco (misurata con UBM)<sup>1,2</sup>

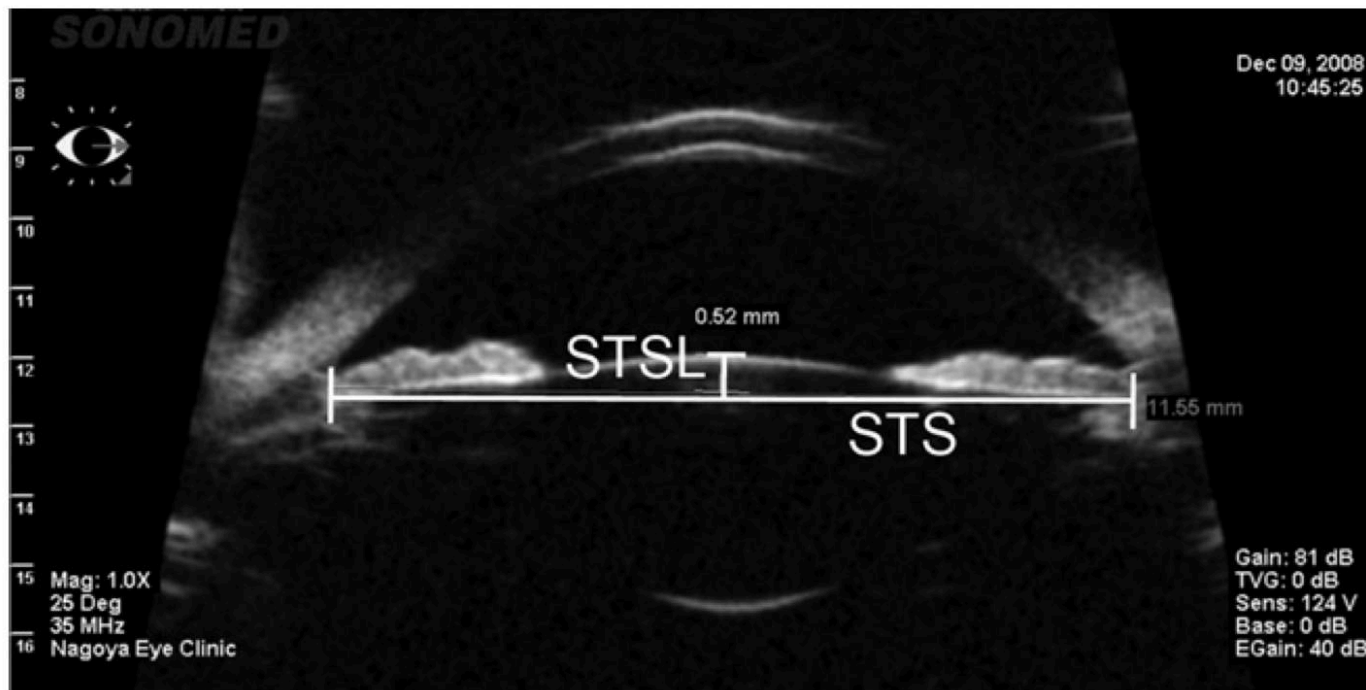
	Bianco-Bianco (calibro)	Solco-Solco (UBM)
Miopi	11.8 ±0.5 mm	12.4 ±0.6 mm
Ipermetropi	12.1 ±0.5 mm	12.3 ±0.5 mm

- ✓ Per informazioni piu' accurate é necessario misurare il solco-solco mediante UBM

1 - Pop M, et al. Predicting sulcus size using ocular measurements. JCRS 2001;27:1033-1038

2 - Oh J, et al. Direct measurement of the ciliary sulcus diameter by 35-MHz ultrasound biomicroscopy. Ophthalmology 2007;114:1685-1688.

# CALCOLO DELLA LENTE



**FIGURE 1.** Representative image of ultrasound biomicroscopy showing the ciliary sulcus-to-sulcus plane (STS) and the distance between ciliary sulcus-to-sulcus plane and anterior crystalline lens surface (STSL) measurements.

Kojima T, et al. Optimization of an implantable collamer lens sizing using high-frequency ultrasound biomicroscopy. *Am J Ophthalmol* 2012;153:632-637

# CALCOLO DELLA LENTE

- ✓ Formula per utilizzare i dati UBM

$$\text{Optimal ICL size (mm, in BSS)} = 3.75 + 0.46 \times \text{STS} + 0.95 \times \text{ACD} + 1.25 \times \text{STSL}$$

STS = sulcus-to-sulcus distance (mm)

ACD = anterior chamber depth, misurata con IOLMaster (dall'endotelio)

STSL = STS to anterior lens surface distance (mm)

Kojima T, et al. Optimization of an implantable collamer lens sizing using high-frequency ultrasound biomicroscopy. Am J Ophthalmol 2012;153:632-637

# CALCOLO DELLALENTE

- ✓ Se non si dispone di UBM si può usare questa formula per calcolare il solco-solco

$$\text{Solco-solco} = 18.9 + (-0.023 \times \text{sfera}) + (-0.15 \times \text{cheratometria media})$$

Pop M, et al. Predicting sulcus size using ocular measurements. JCRS 2001;27:1033-1038

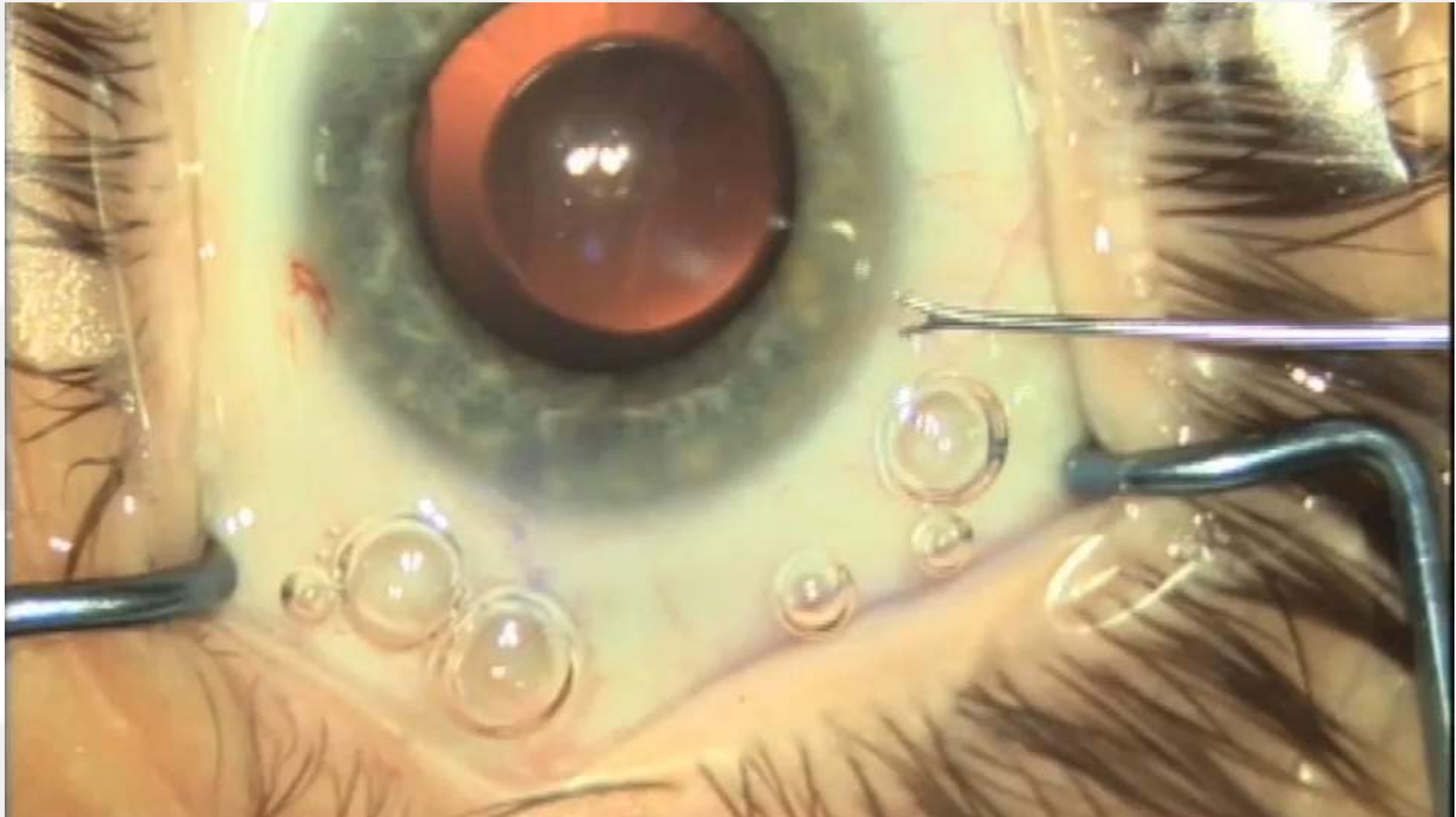
# CALCOLO DELLA LENTE

## ICL TORICHE

- ✓ Per minimizzare la rotazione durante l'impianto le ICL toriche sono customizzate per essere posizionate sull'asse orizzontale.
- ✓ Tempo fra ordine e consegna: 3-4 mesi
- ✓ Per ridurre l'attesa il chirurgo può scegliere una ICL già disponibile (con lo stesso potere) ma con asse diverso (entro  $22.5^\circ$ )
- ✓ La ICL torica deve essere ruotata per compensare la differenza nell'asse

# TECNICA CHIRURGICA

# TECNICA CHIRURGICA





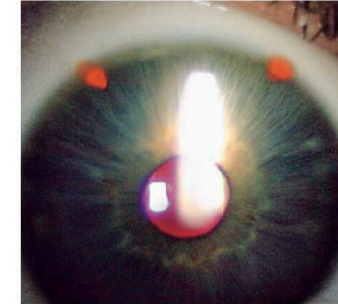
# IRIDOTOMIA

- ✓ Meglio 2 iridotomie (ore 10.30 e 1.30), lontane dalle anse dell'ICL
- ✓ YAG laser (1-2 settimane prima dell'intervento)
- ✓ Intraop (Vannas o vitrectomo)
- ✓ Sufficientemente ampie (500  $\mu\text{m}$ )

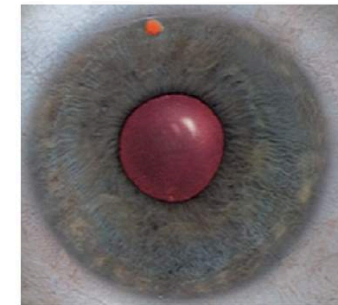
# IRIDOTOMIA

## Tips for making PIs:

	YAG PI	Surgical PI by Scissors	Surgical PI by Vitrector
<b>Size and number</b>	Approximately 1 mm, 2 PIs required.	Require more experience to control. Usually range from 1 mm to 2 mm. Only 1 PI required. If too big, may interfere with vision.	Require more experience to control. Usually range from 1 mm to 2 mm. Only 1 PI required. If too big, may interfere with vision.
<b>Location</b>	Keep peripheral enough to avoid interference with vision, but not so peripheral that they do not function properly. PIs should be at least 90 degrees apart (approximately 10:30 and 1:30 o'clock).	Keep peripheral enough to avoid interference with vision, but not so peripheral that they do not function properly. Approximately 12 o'clock.	Keep peripheral enough to avoid interference with vision, but not so peripheral that they do not function properly. Approximately 12 o'clock.
<b>Permeability</b>	Ensure penetration of the pigment epithelium. Double-check full thickness permeability before surgery and re-YAG if needed.	Ensure penetration of the pigment epithelium. Ensure aspiration of pigment to avoid IOP spike after surgery.	Ensure penetration of the pigment epithelium. Ensure aspiration of pigment to avoid IOP spike after surgery.



Yag-PIs done prior to surgery at 10:30 and 1:30 o'clock



PI done with vitrector nearly at 12 o'clock. Main incision must be temporal

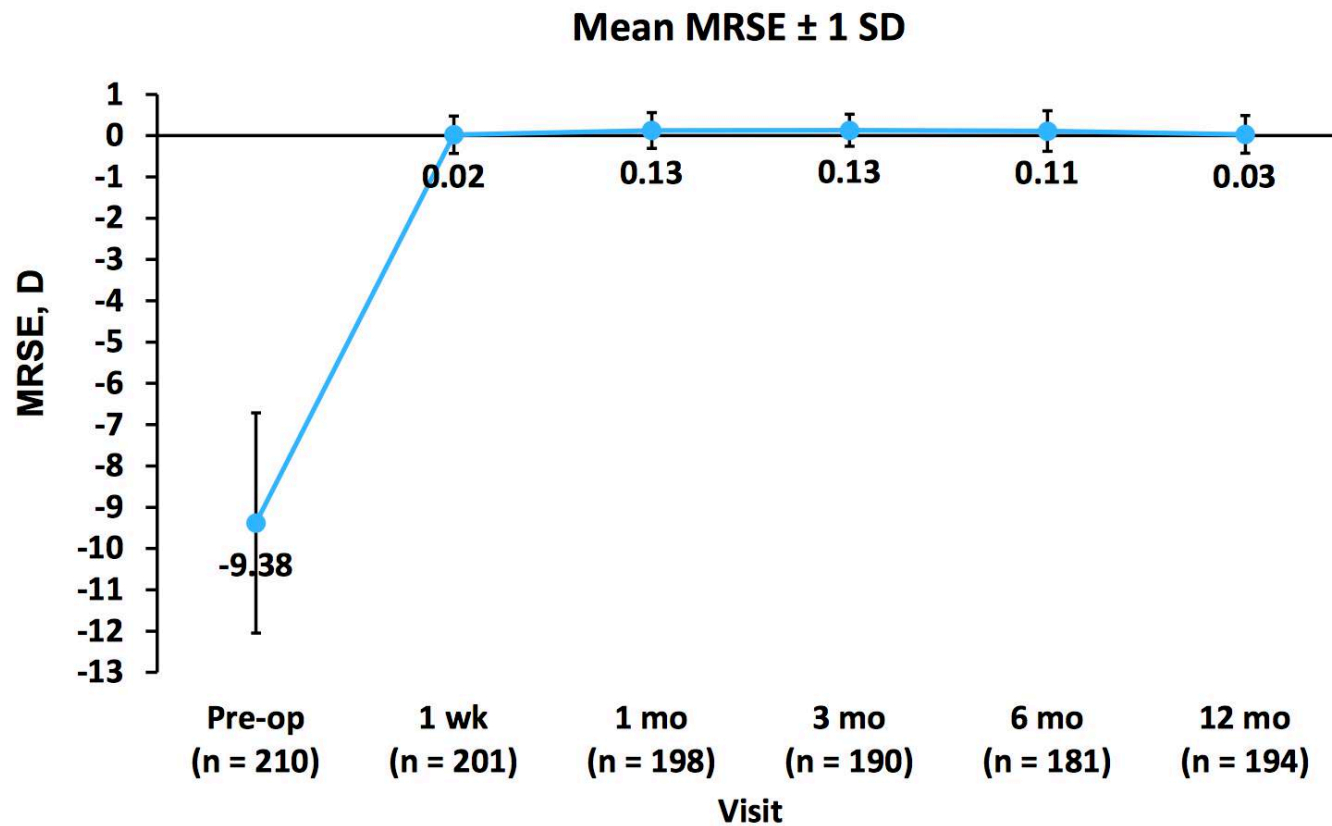
# RISULTATI

- ✓ REFRAZIONE
- ✓ ACUITA' VISIVA
- ✓ SODDISFAZIONE DEL PAZIENTE
- ✓ QUALITA' DELLA VISIONE
- ✓ STABILITA' ROTAZIONALE

# REFRAZIONE

CE-31

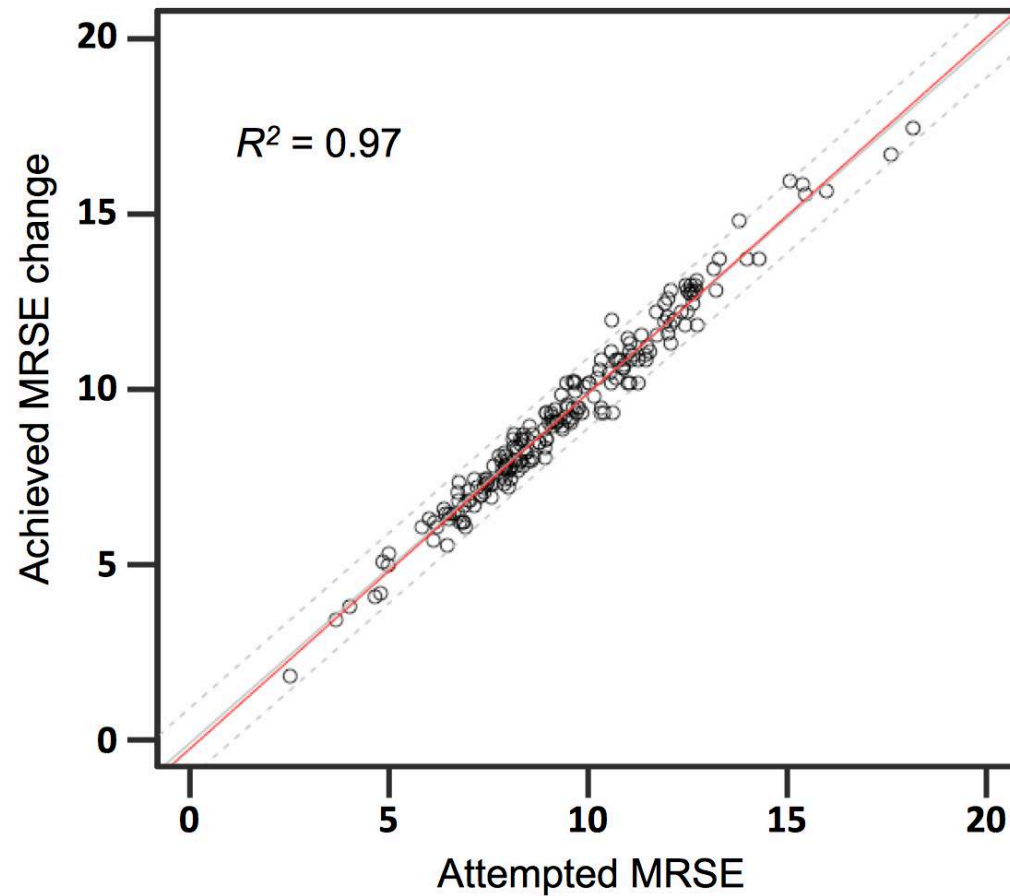
## MRSE Over Time



# REFRAZIONE

CE-32

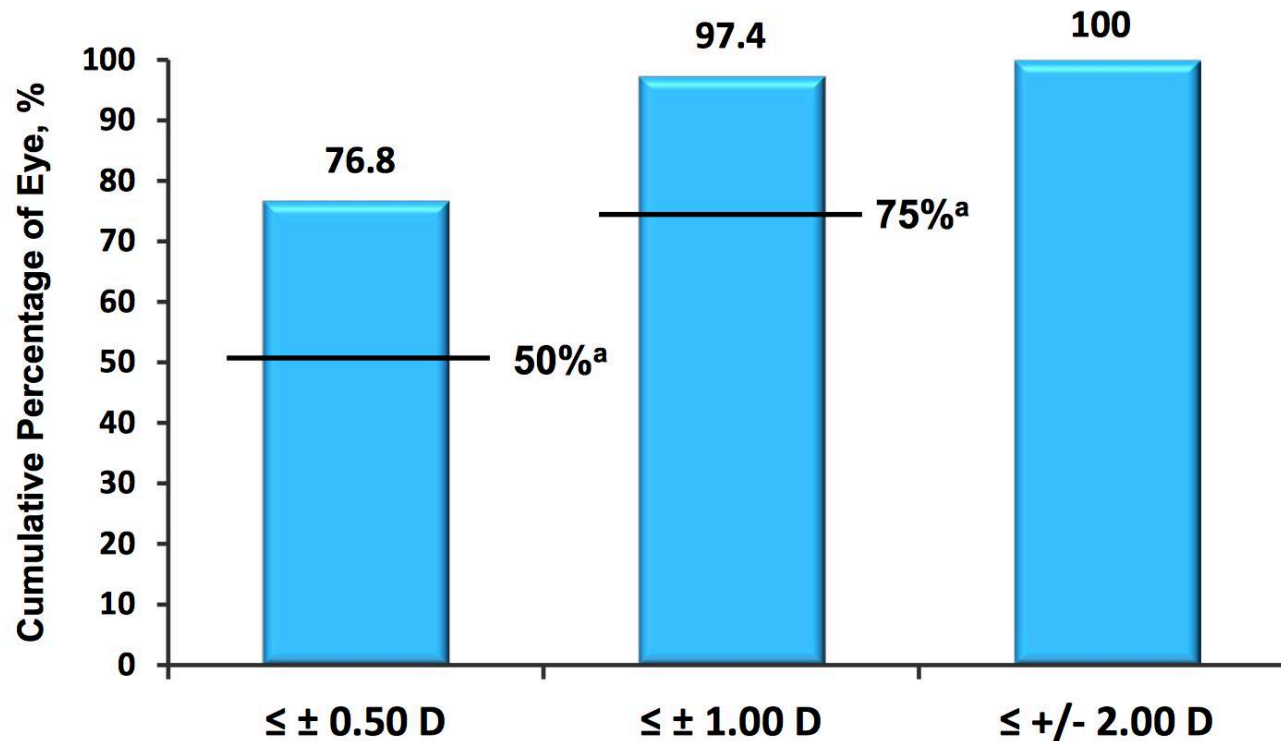
## Predictability—Attempted vs Achieved MRSE at 12 Mo



# REFRAZIONE

CE-33

## Predictability of MRSE (12 Mo) (n = 194)

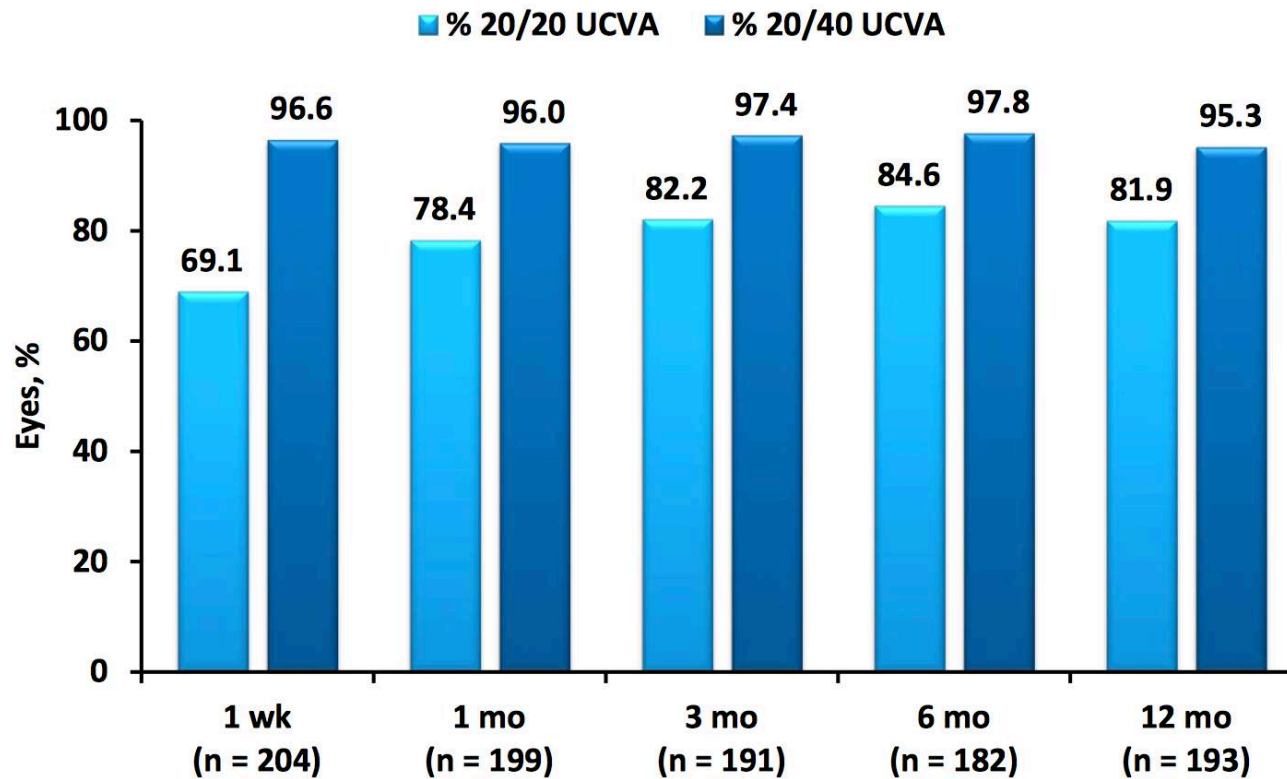


<sup>a</sup> Protocol target derived from FDA Draft Guidance. *Refractive Implants: Investigational Device Exemptions (IDEs) and Premarket Approval Applications (PMAs)*. <http://www.fda.gov/ohrms/dockets/98fr/001385gd.pdf>.

# ACUITA' VISIVA

CE-41

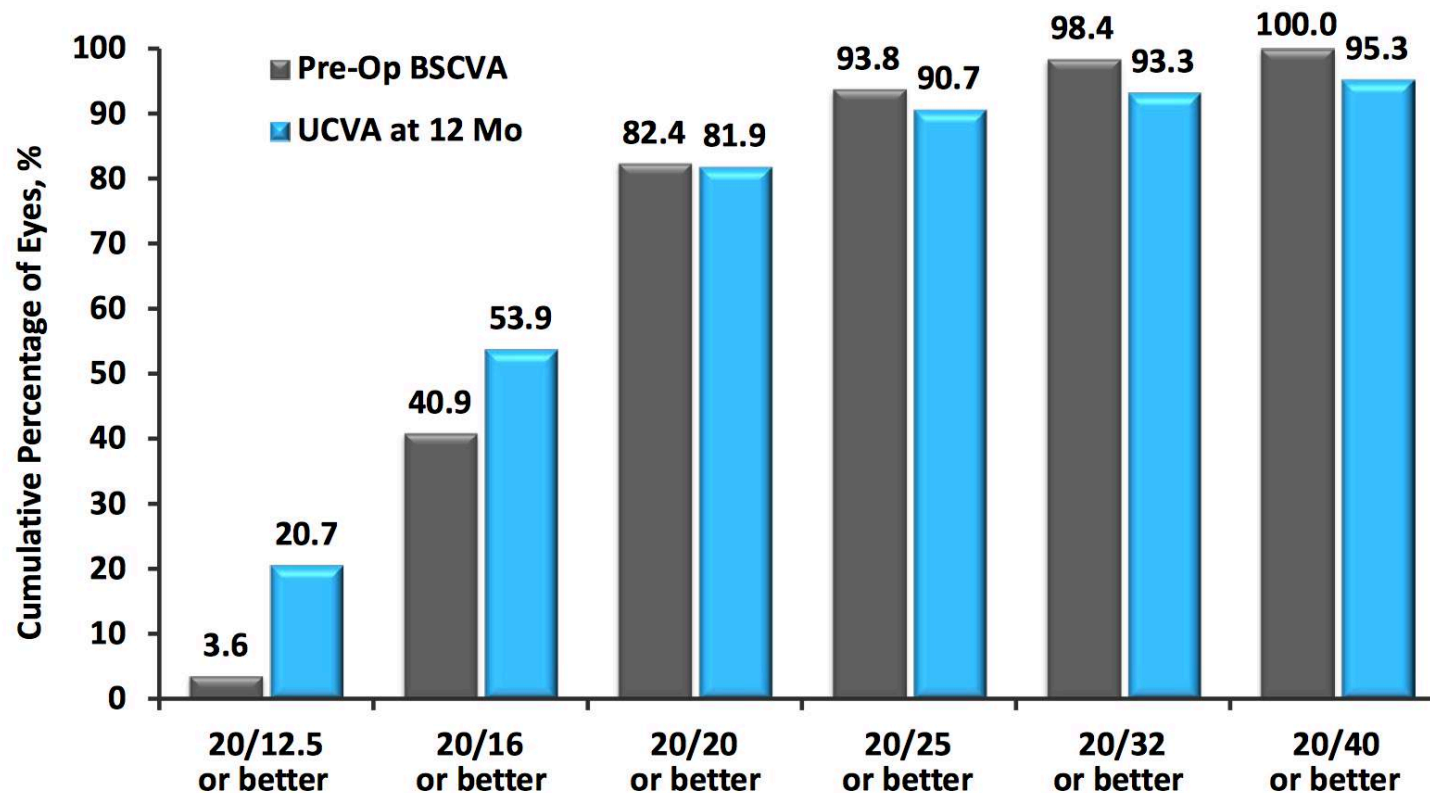
## Achieving 20/20 and 20/40 or Better UCVA Over Time



# ACUITA' VISIVA

CE-42

## Uncorrected Visual Acuity (UCVA) at 12 Mo vs Pre-Operative BSCVA (Cumulative) (n = 193)

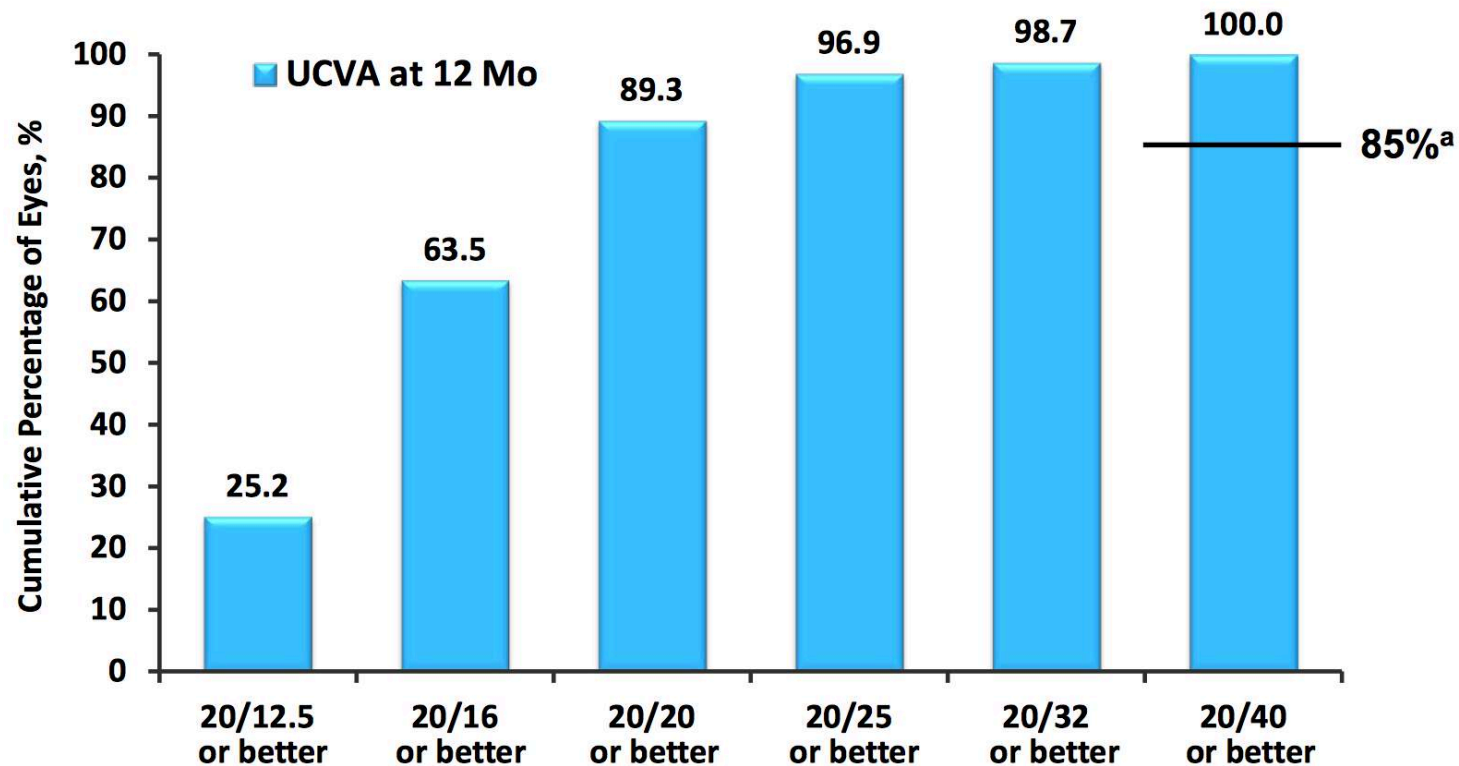




# ACUITA' VISIVA

CE-43

## UCVA at 12 Months (Cumulative) in Eyes with Pre-op BSCVA 20/20 or Better (n = 159)



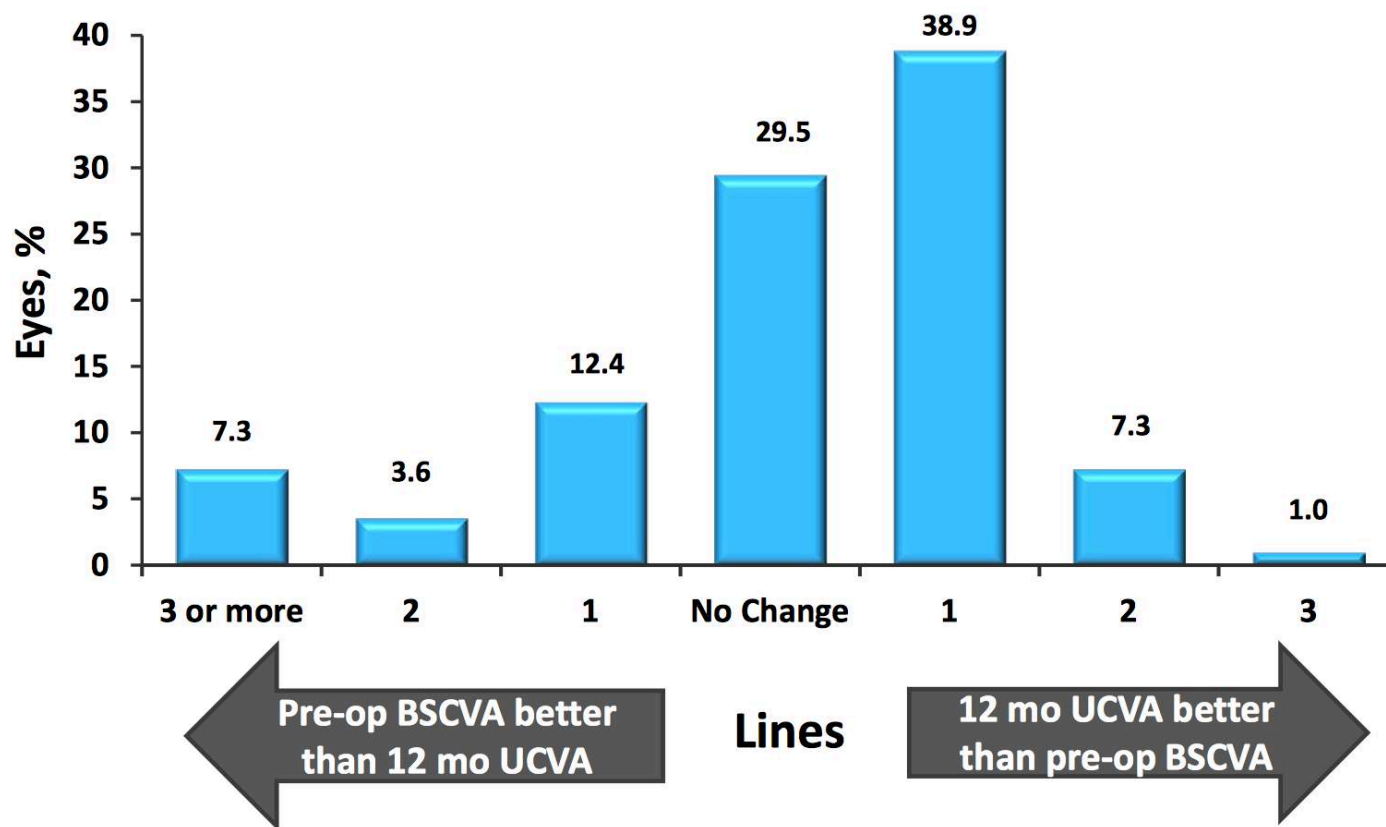
<sup>a</sup> Protocol target derived from FDA Draft Guidance. *Refractive Implants: Investigational Device Exemptions (IDEs) and Premarket Approval Applications (PMAs)*. <http://www.fda.gov/ohrms/dockets/98fr/001385gd.pdf>.

# ACUITA' VISIVA

CE-44

## Difference Between 12 Mo UCVA and Pre-Op BSCVA (N = 194)

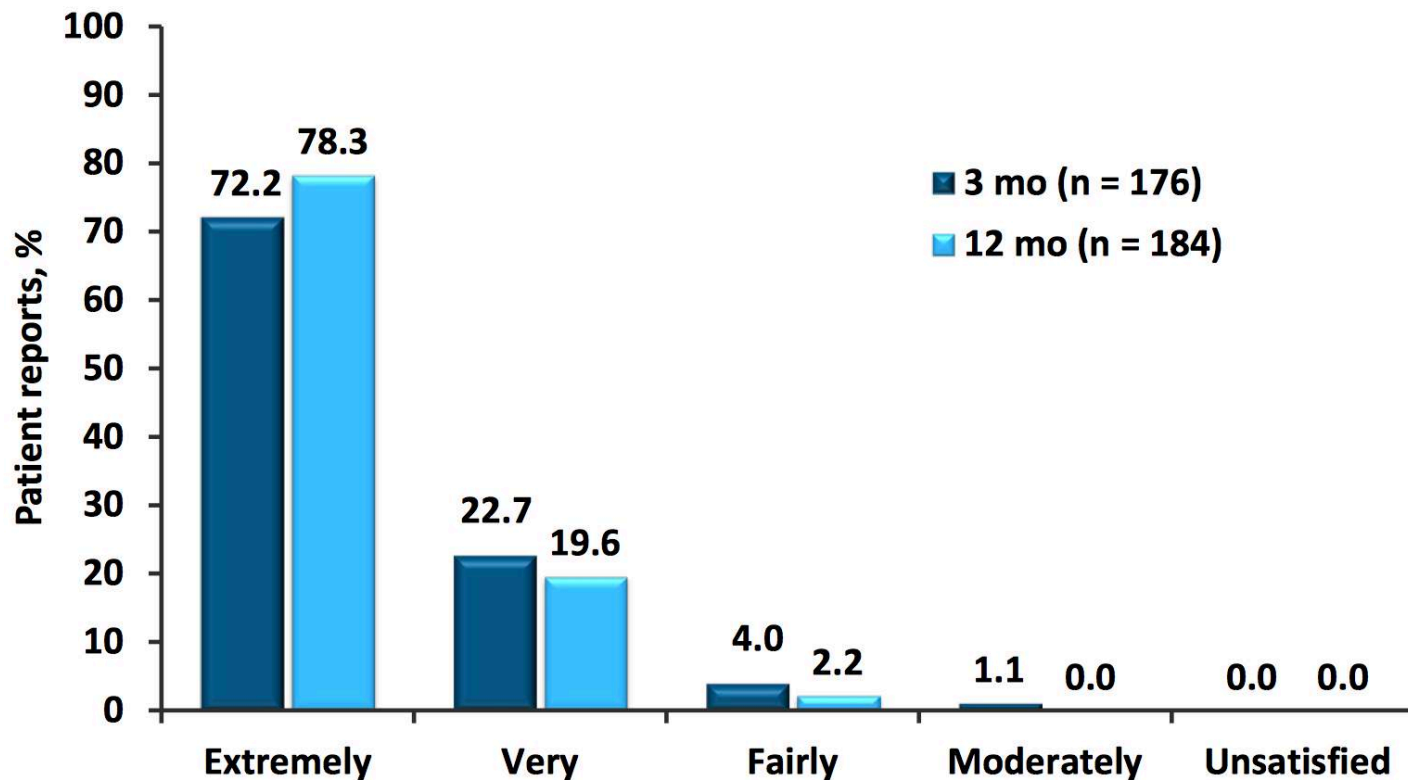
76.7% of eyes had 12 mo UCVA as good as or better than pre-op BSCVA



# SODDISFAZIONE DEL PAZIENTE

CE-46

## Patient Satisfaction With Surgery

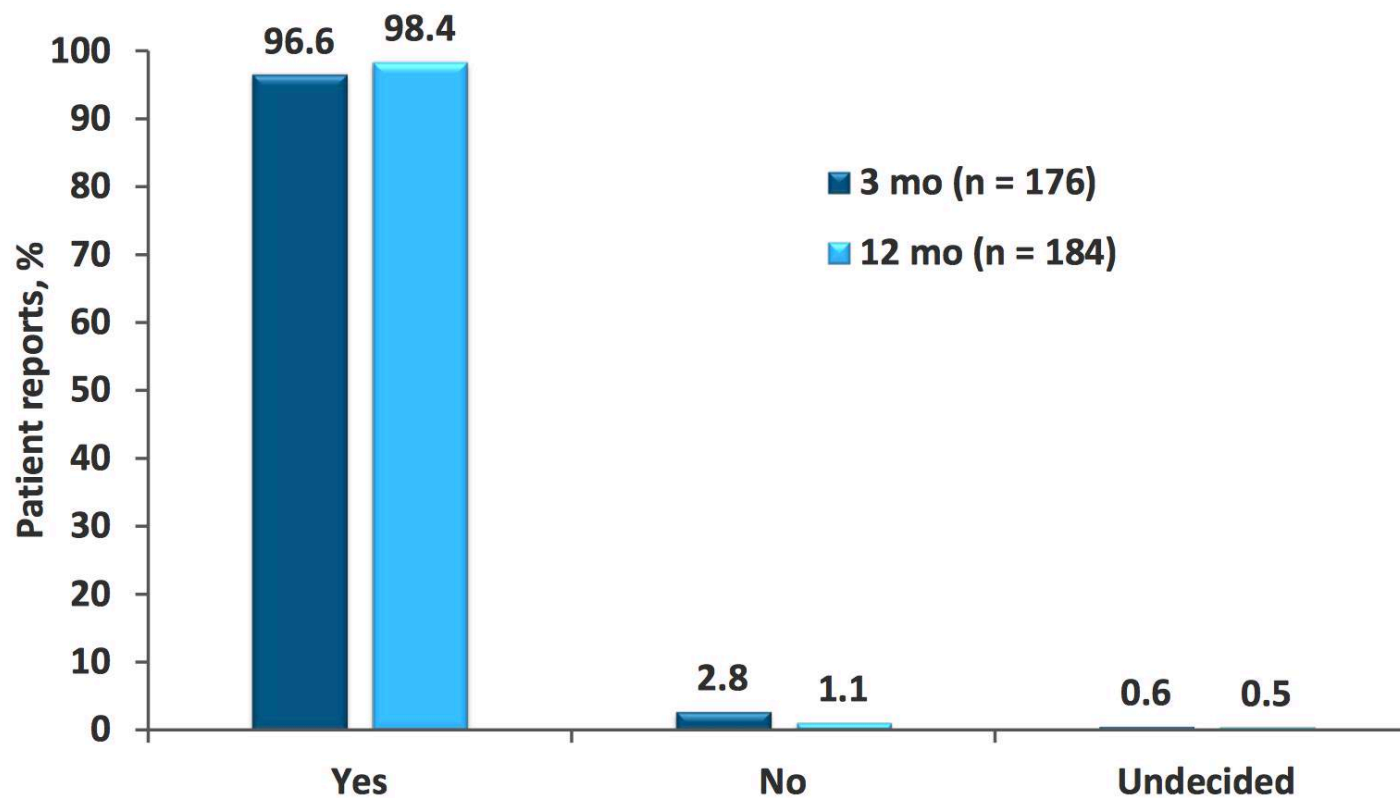


Note: 15 patients at 3 mo postoperatively did not report; 10 patients at 12 mo postoperatively did not report.

# SODDISFAZIONE DEL PAZIENTE

CE-47

## Patient Willingness to Have Surgery Again

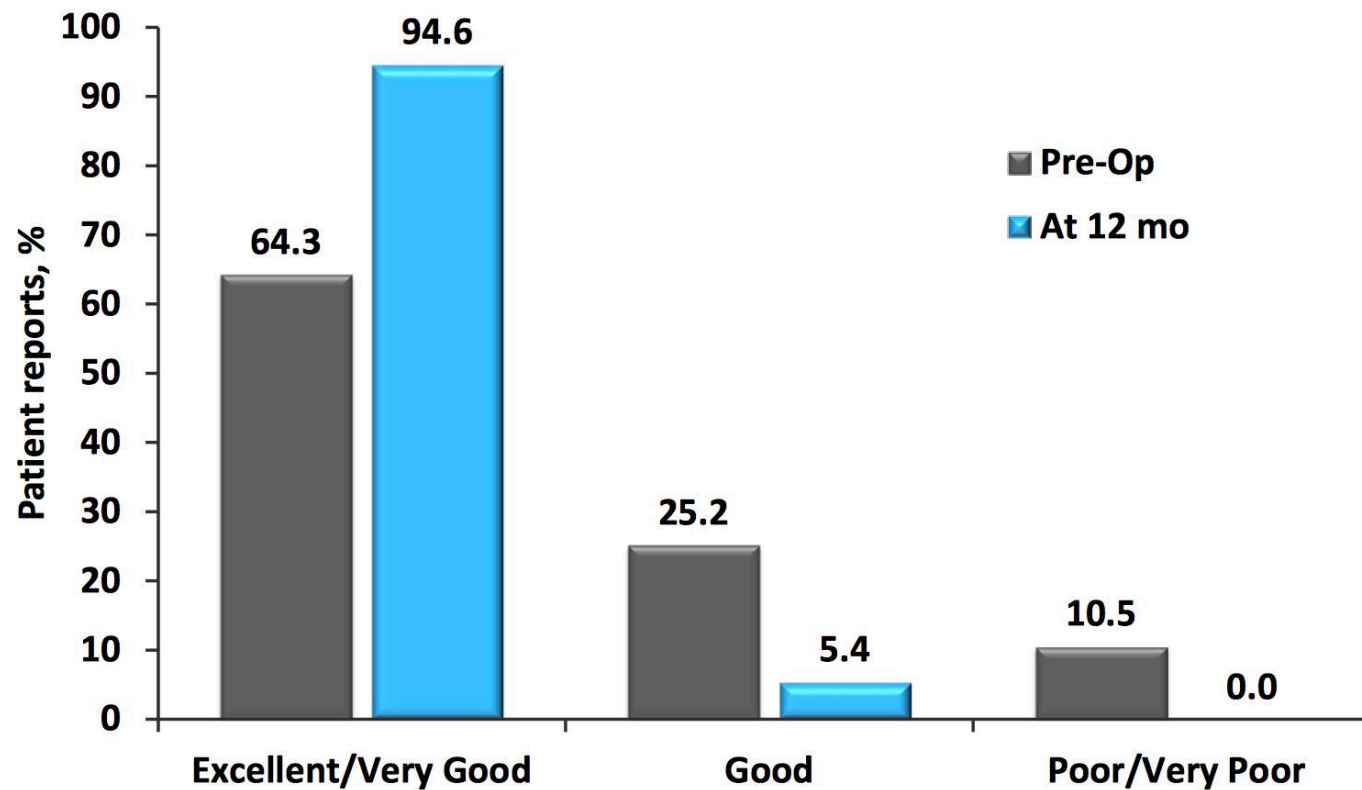


Note: 15 patients at 3 mo postoperatively did not report; 10 patients at 12 mo postoperatively did not report.

# QUALITA' DELLA VISIONE

CE-48

## Patient Rating of Quality of Vision at 12 mo (n = 184)

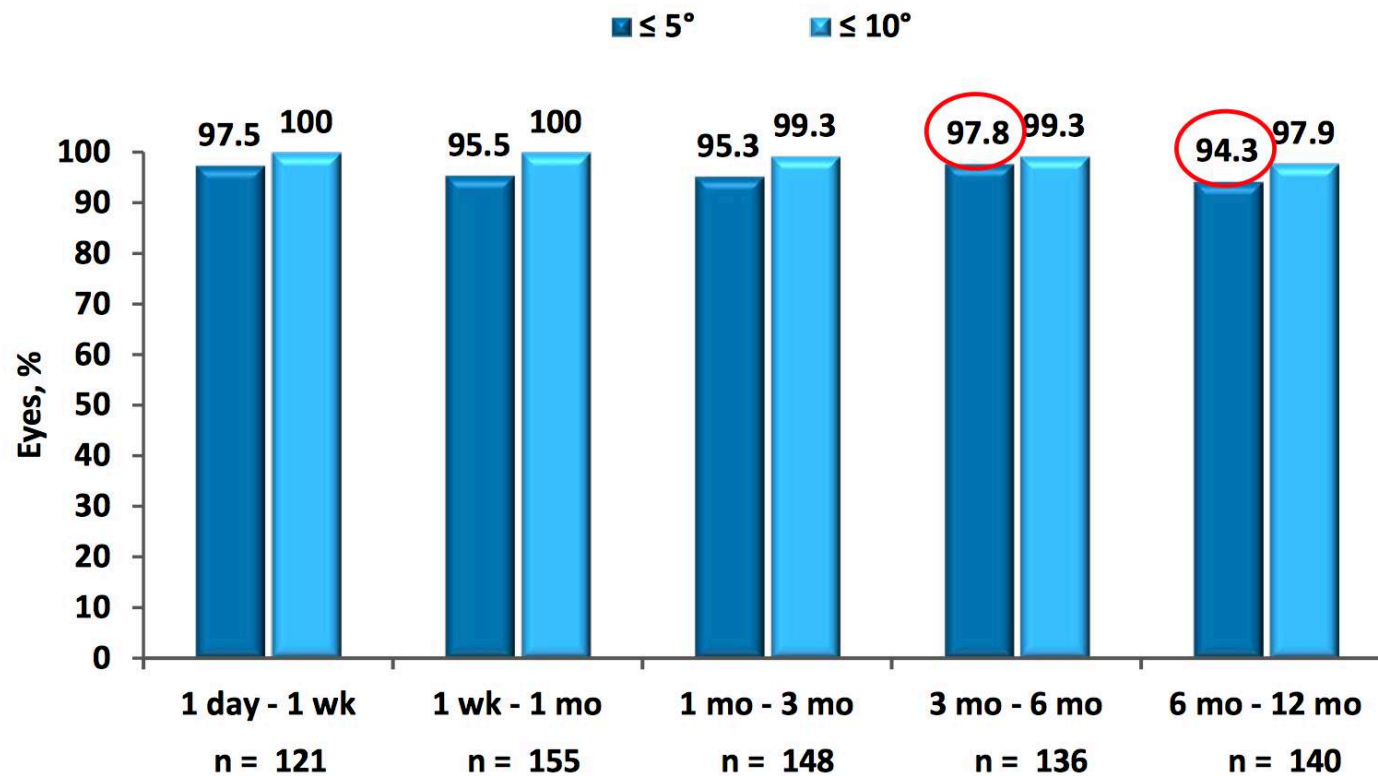


Note: 10 patients at 12 mo postoperatively did not report.

# STABILITA' ROTAZIONALE

CE-52

## Stability of Axis Orientation (Slit Lamp)



ANSI Z80.30-2010: Stability of the toric IOL axis is achieved if 90% of the treated eyes rotate  $\leq 5^\circ$  between 2 consecutive visits, at least 3 mo apart.

# FOLLOW-UP

✓ 2-4 ore

✓ 1 giorno

✓ 1 settimana

✓ 1 mese

✓ 1 anno

✓ IOP

✓ Vaulting

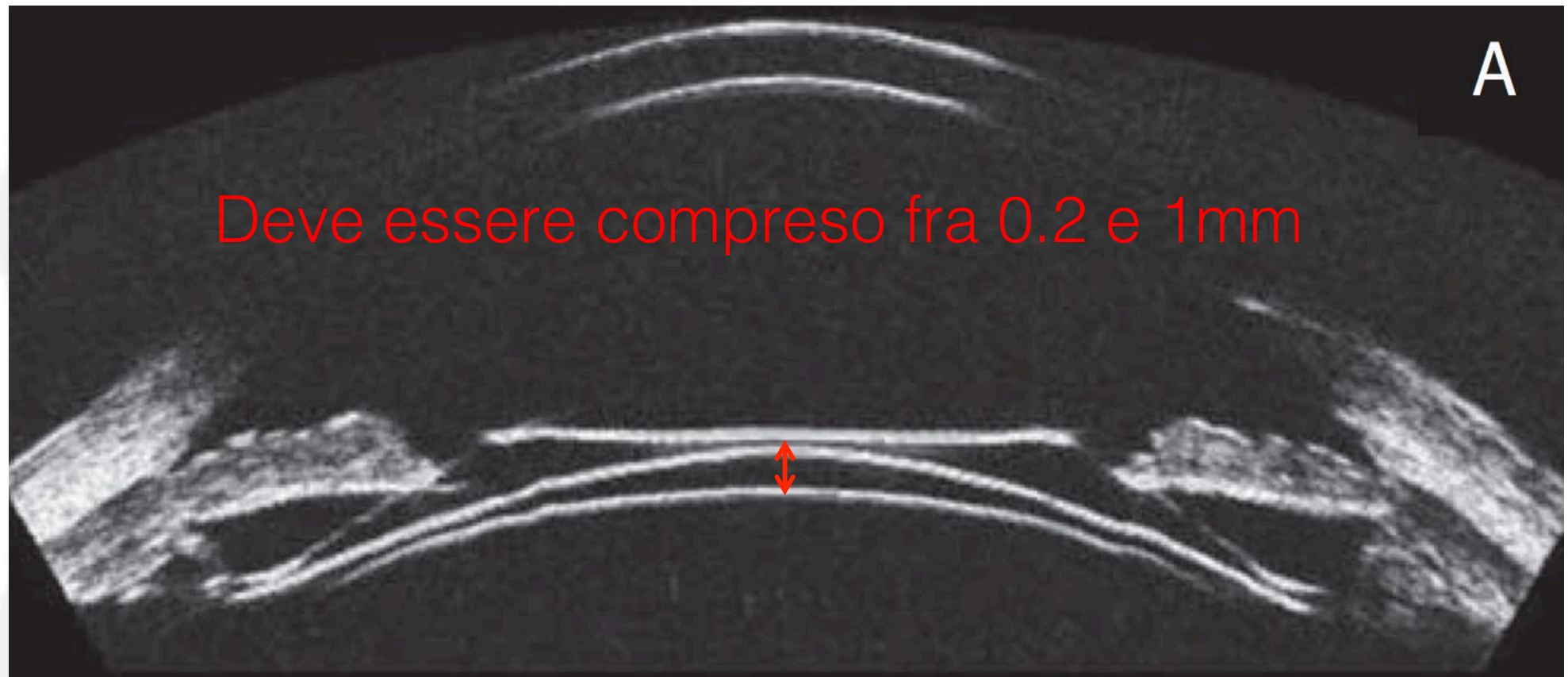
✓ Refrazione

✓ Acuità visiva

✓ Conta cellule endot.

# FOLLOW-UP

- ✓ Vaulting = distanza fra ICL e cristallino



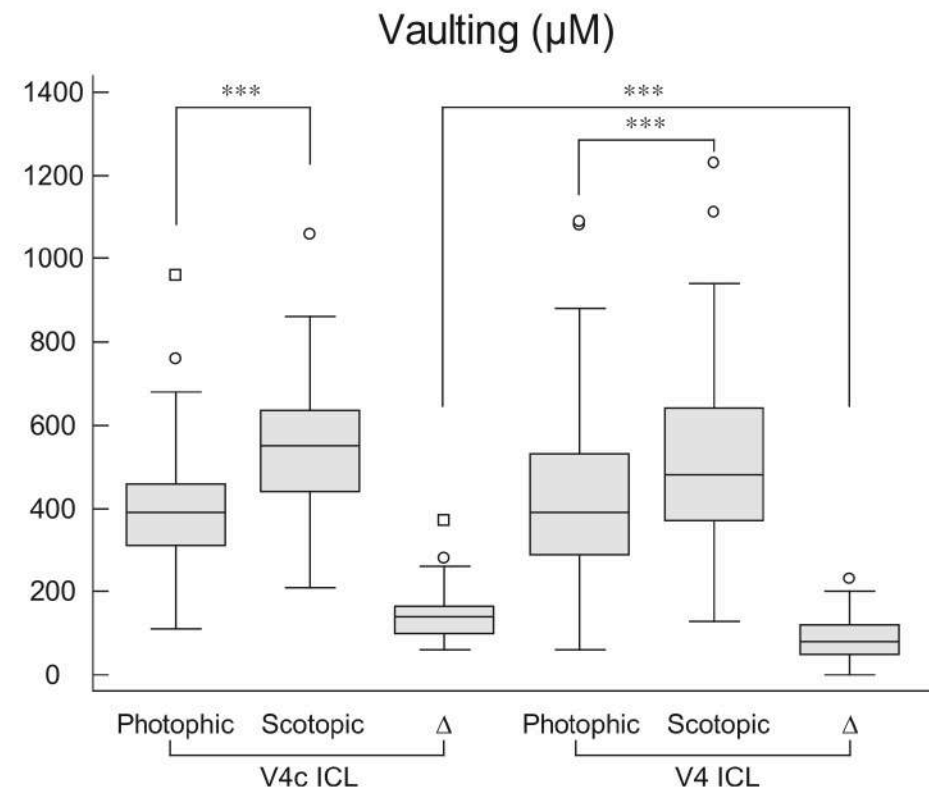


# FOLLOW-UP

✓ Vaulting = distanza fra ICL e cristallino

Differenza fra condizioni scotopiche e fotopiche

- Con pupilla dilatata il vaulting aumenta



Lee H, et al. Dynamic vaulting changes in V4c versus V4 posterior chamber phakic lenses under differing lighting conditions. Am J Ophthalmol 2014; 158:1199-1204

# CONFRONTO ICL vs LASIK

- ✓ ICL inducono meno aberrazioni di alto ordine rispetto alla LASIK<sup>1,2</sup>
- ✓ Sensibilità al contrasto migliorata dopo impianto di ICL nelle miopie di lieve/ media entità. Dopo LASIK peggioramento della sensibilità al contrasto nelle miopie elevate<sup>1,2</sup>

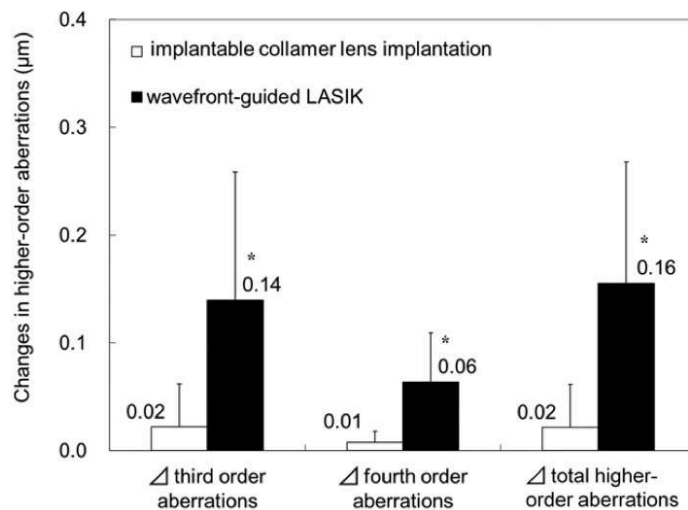
1 – Kamiya K, et al. Visual performance after posterior chamber phakic intraocular lens implantation and wavefront-guided laser in situ keratomileusis for low to moderate myopia. Am J Ophthalmol 2012;153:1178-1186

2 – Igarashi A, et al. Visual performance after posterior chamber phakic intraocular lens implantation and wavefront-guided laser in situ keratomileusis for high myopia. Am J Ophthalmol 2009;148:164-170

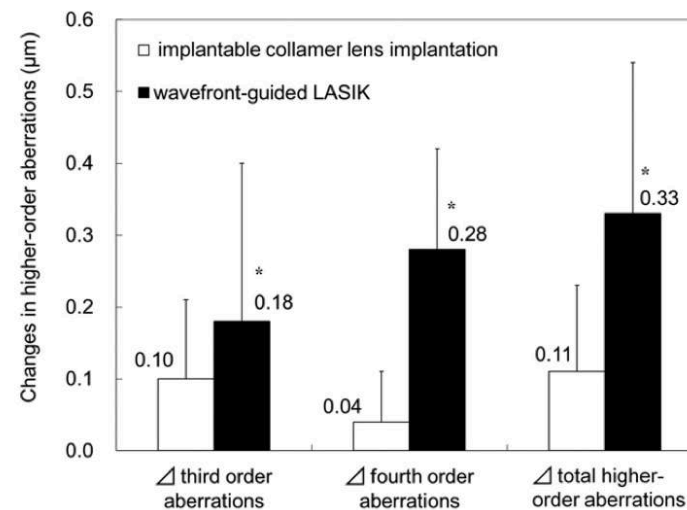
# CONFRONTO ICL vs LASIK

MIOPIE BASSE (3.00 - 5.88 D)

## ✓ Aberrazioni alto ordine



Pupilla 4mm

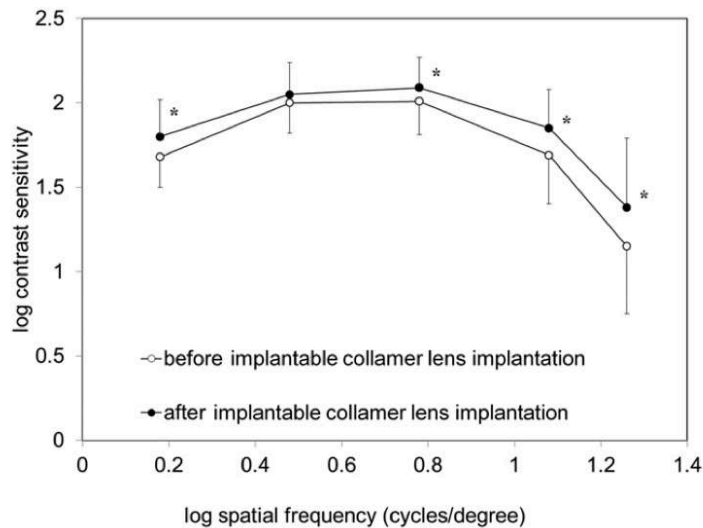


Pupilla 6mm

# CONFRONTO ICL vs LASIK

MIOPIE BASSE (3.00 - 5.88 D)

✓ Sensibilità al contrasto



ICL

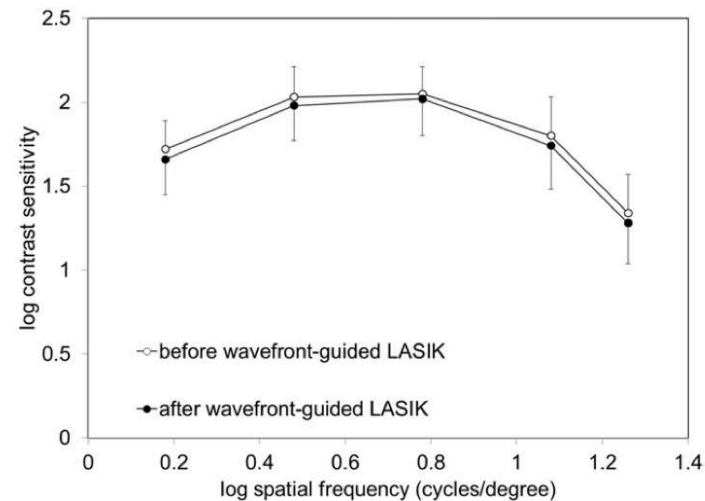


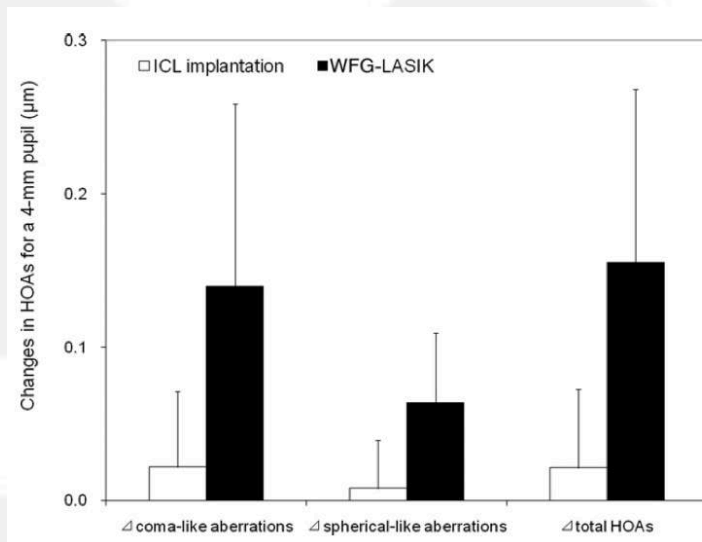
FIGURE 4. Contrast sensitivity at 5 spatial frequencies before

LASIK

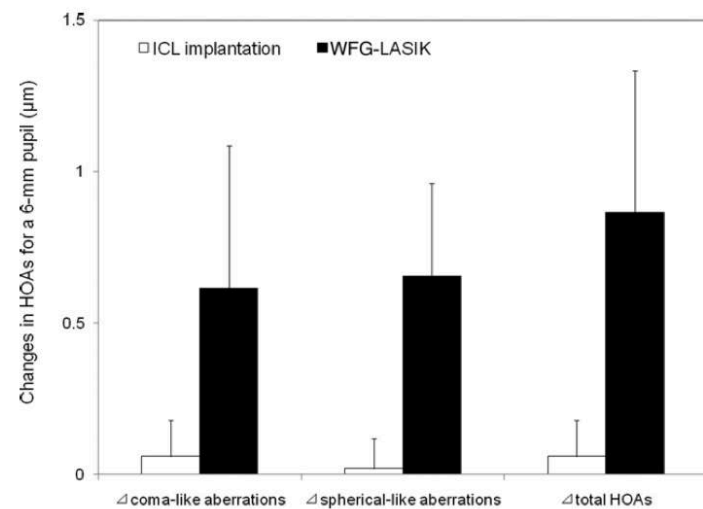
# CONFRONTO ICL vs LASIK

MIOPIE ALTE (ICL: 6.00 – 21.00 D, LASIK: 6.00 – 11.25)

✓ Aberrazioni di alto ordine



Pupilla 4mm

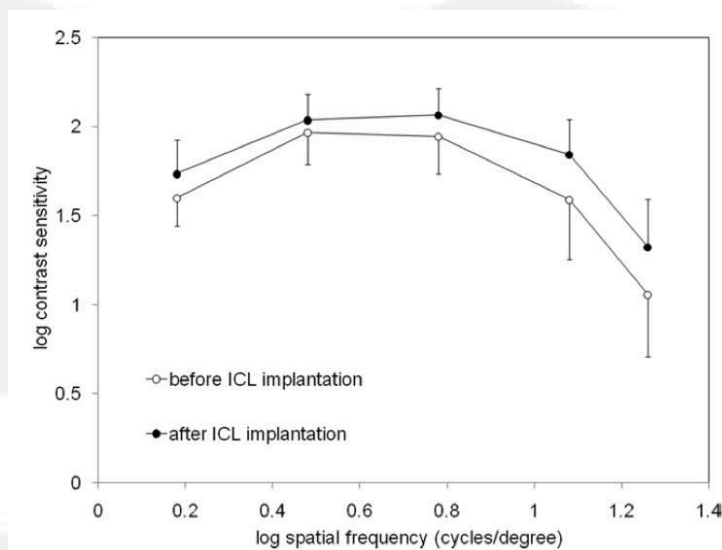


Pupilla 6mm

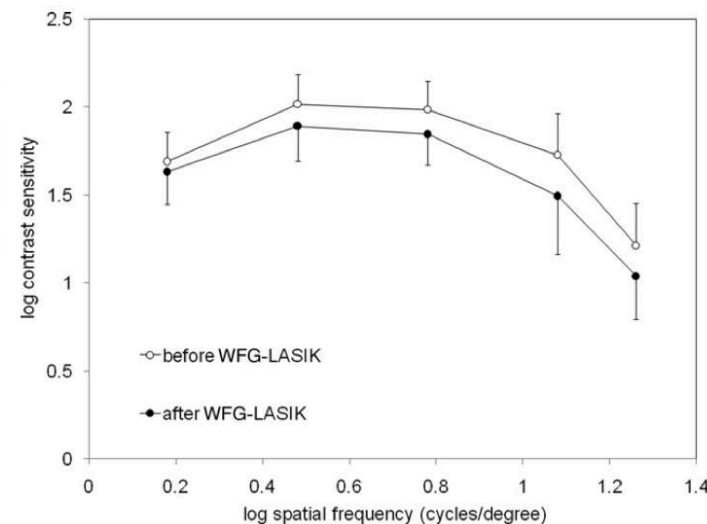
# CONFRONTO ICL vs LASIK

MIOPIE ALTE (ICL: 6.00 – 21.00 D, LASIK: 6.00 – 11.25)

✓ Sensibilità al contrasto



ICL



LASIK

# COMPLICANZE

- ✓ CATARATTA
- ✓ GLAUCOMA
- ✓ ALONI
- ✓ PERDITA CELLULE ENDOTELIALI
- ✓ DISLOCAZIONE
- ✓ ENDOFTALMITE

# CATARATTA

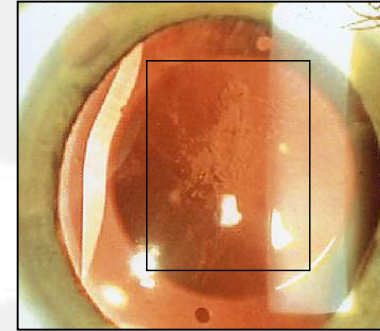
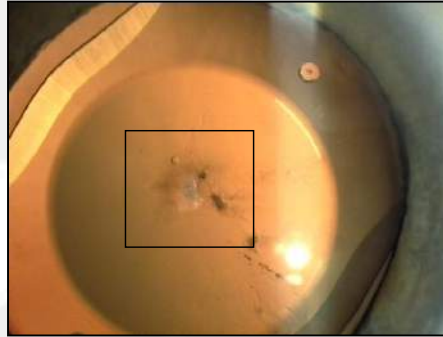
- ✓ Incidenza complessiva: 5.2%<sup>1</sup>
- ✓ Nella maggior parte dei casi: cataratta sottocapsulare anteriore
- ✓ Range ICL miopia: 1.3-28%  
ICL ipermetropia: 6-14.3%  
ICL astigmatismo: 2.3-10.4%
- ✓ Quando si sviluppa la cataratta?  
43.4% entro 1 anno  
15.4% fra 1 e 3 anni  
35.3% oltre 3 anni

1 – Fernandes P, et al. Implantable collamer posterior chamber intraocular lenses: a review of potential complications. J Refract Surg 2011;27:765-776

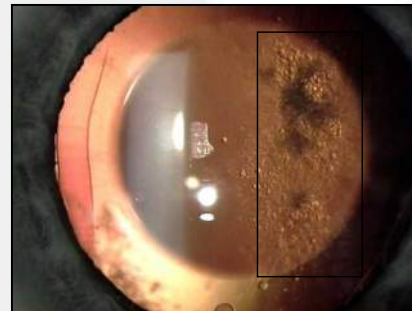


# CATARATTA

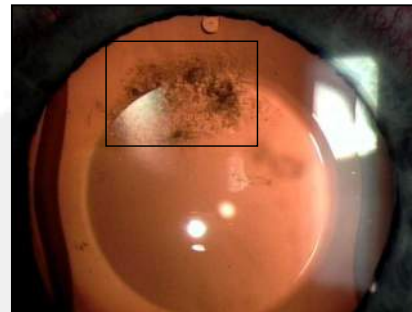
✓ Centrale



✓ Paracentrale



✓ Periferica



Courtesy of L. Werner

# CATARATTA

- ✓ Percentuale espianto ICL: 0.61%<sup>1</sup>
- ✓ Studio condotto su 3420 occhi
- ✓ Solo modelli più recenti (V4, V4b e V4c), in cui il vaulting è stato aumentato per ridurre la cataratta
- ✓ Intervallo medio fra impianto ICL e chirurgia cataratta: 4.2 anni (range 1-7 anni)
- ✓ Nessun caso di cataratta ancora riportato dopo impianto di V4c

1 – Alfonso JF, et al. Prevalence of cataract after collagen copolymer phakic intraocular lens implantation for myopia, hyperopia and astigmatism. J Cataract Refract Surg 2015;41:800-805

# CATARATTA

Le cataratte precoci sono causate da:

- ✓ Trauma chirurgico (contatto ICL-cristallino). Curva di apprendimento
- ✓ Contatto fra ICL e cristallino nel decorso postoperatorio

Nella maggior parte dei casi sono opacità focali che non causano riduzione visus e non richiedono intervento chirurgico

# CATARATTA

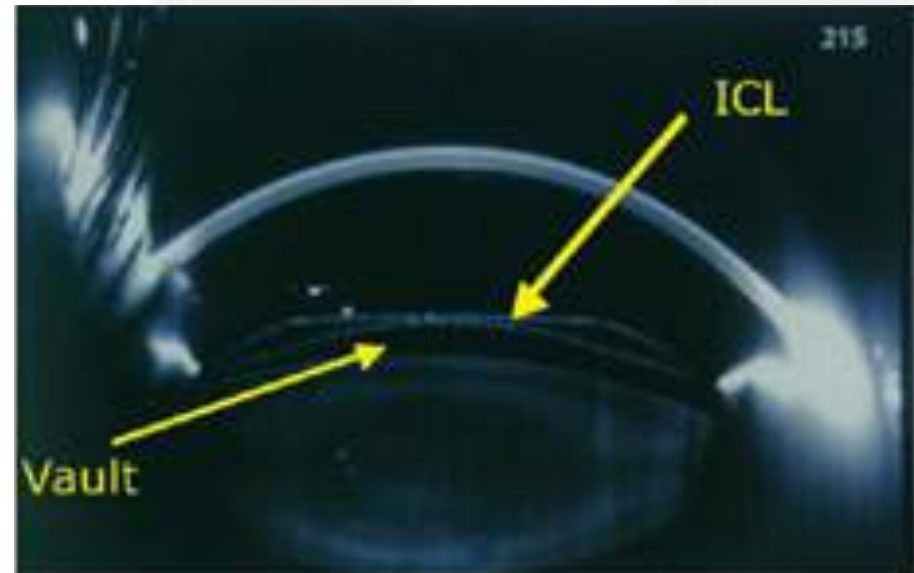
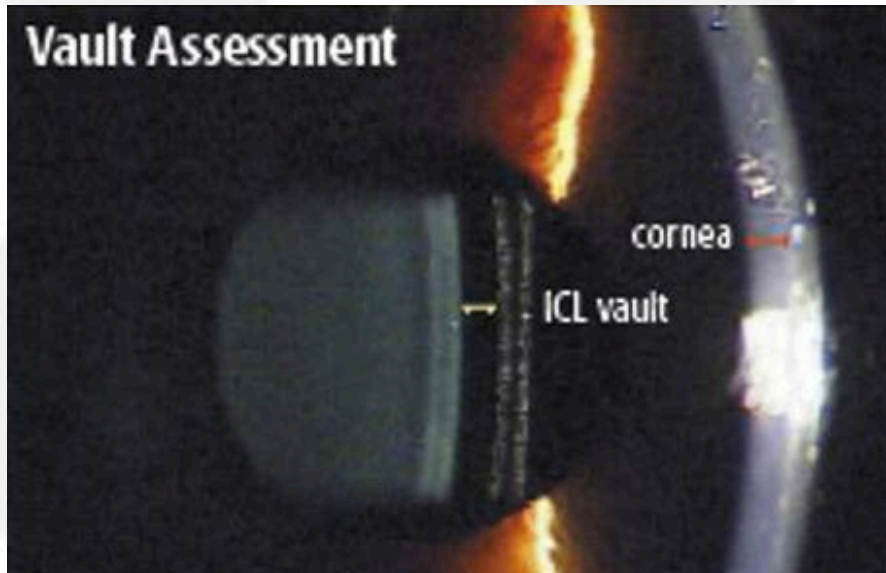
Distanza Cristallino-ICL (vaulting)

- ✓ Trauma da contatto diretto
- ✓ Disturbi nel flusso dell'acqueo con alterazioni metaboliche del cristallino

Valori inferiori a 200  $\mu\text{m}$  sono considerati pericolosi

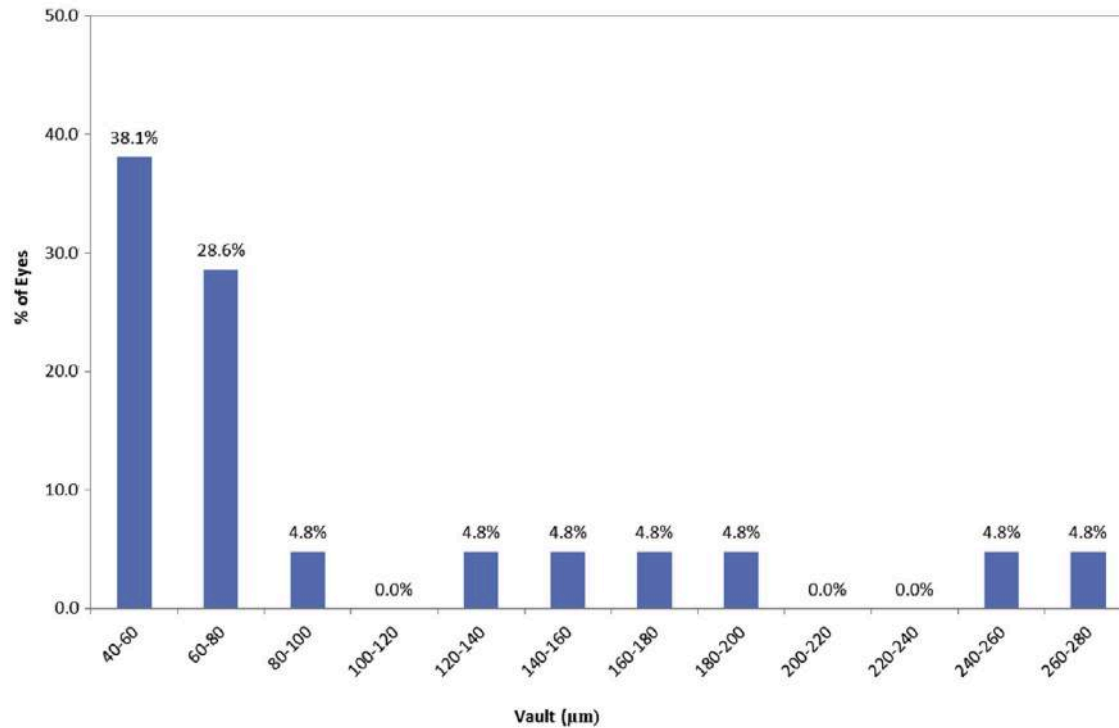
# CATARATTA

Valore ideale VAULTING: 0.20-0.75 mm



- ✓ Vaulting  $<0.2\text{mm}$ : rischio cataratta
- ✓ Vaulting  $>0.75\text{mm}$ : rischio glaucoma
- ✓ Un vaulting insufficiente ( $<0.2\text{mm}$ ) dipende da una lunghezza insufficiente dell'ICL

# CATARACTA



**Figure 3.** Vault distance values before cataract surgery in 21 eyes that developed cataracts after pIOL implantation.

Alfonso JF, et al. JCRS 2015;41:800-805

J CATARACT REFRACT SURG - VOL 41, APRIL 2015

La cataratta può svilupparsi (raramente) anche con vaulting > 0.20mm

# CATARATTA

Come comportarsi in caso di rimozione della cataratta?

✓ La presenza dell'ICL non influisce sulle misurazioni della lunghezza assiale con IOLMaster (Sanders et al JRS 2008)

✓ Rimozione ICL

✓ Facio

# GLAUCOMA

Diversi meccanismi patogenetici

- ✓ Aumento precoce della IOP (rimozione incompleta viscoelastico)
- ✓ Glaucoma da blocco pupillare (assenza iridotomie oppure vaulting eccessivo causato da lente con dimensioni troppo elevate)
- ✓ Glaucoma da dispersione di pigmento (vaulting eccessivo)



# GLAUCOMA

Diversi meccanismi patogenetici

- ✓ Aumento precoce della IOP
- ✓ Glaucoma da blocco pupillare
- ✓ Glaucoma pseudofacomorfico
- ✓ Glaucoma da dispersione di pigmento

# GLAUCOMA

Aumento precoce della IOP

- ✓ Causato da rimozione incompleta del viscoelastico (con blocco delle iridectomie o del foro centrale)
- ✓ 4% dei casi<sup>1</sup>
- ✓ Revisione chirurgica
- ✓ Diamox / Mannitolo

1 - Implantable Contact Lens in the Treatment of Myopia (ITM) Study Group. U.S. Food and Drug Administration clinical trial of the implantable contact lens for moderate to high myopia. Ophthalmology 2003; 110:255-266

# GLAUCOMA

Glaucoma da blocco pupillare

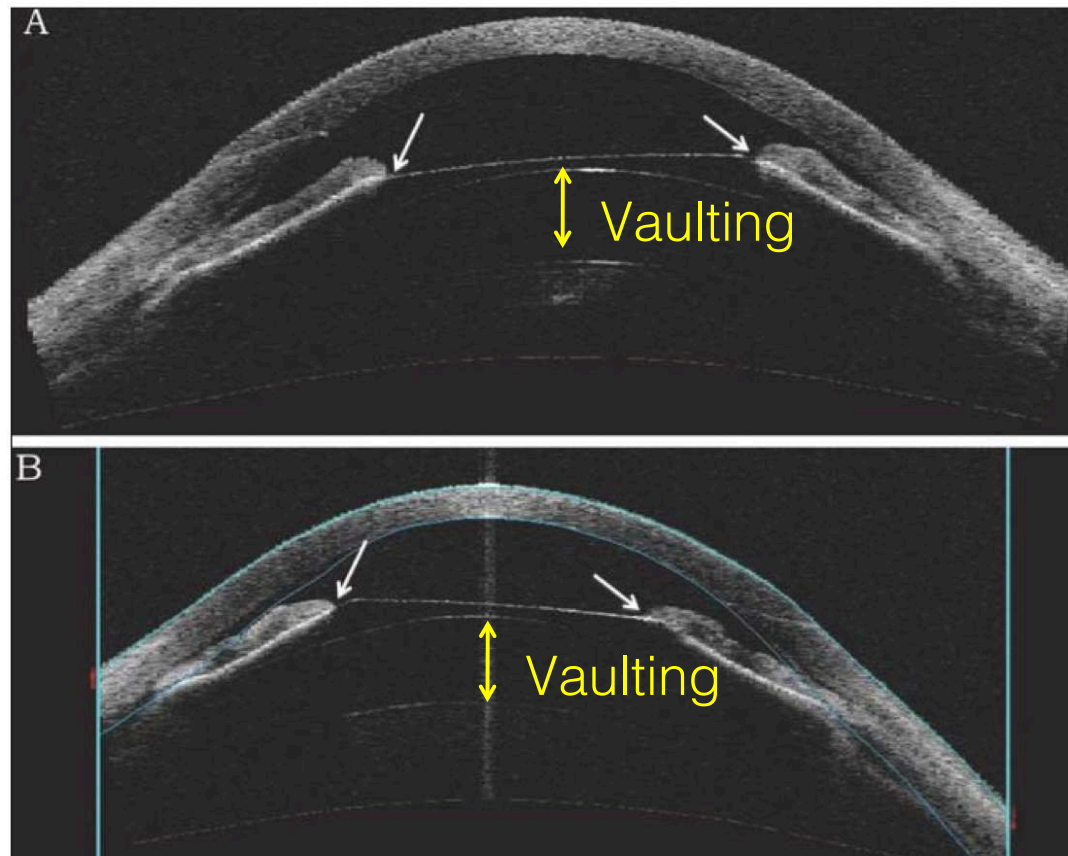
- ✓ Tipico delle ICL senza foro
- ✓ Causato da contatto fra ICL e superficie posteriore dell'iride in assenza di iridotomia pervia
- ✓ Soluzione: iridotomia

# GLAUCOMA

## Glaucoma pseudofacomorfico

- ✓ Causato da oversizing dell'ICL > eccessivo vaulting > spinta in avanti dell'iride con chiusura dell'angolo (nonostante iridotomie pervie)
- ✓ Rimozione/sostituzione/rotazione dell'ICL

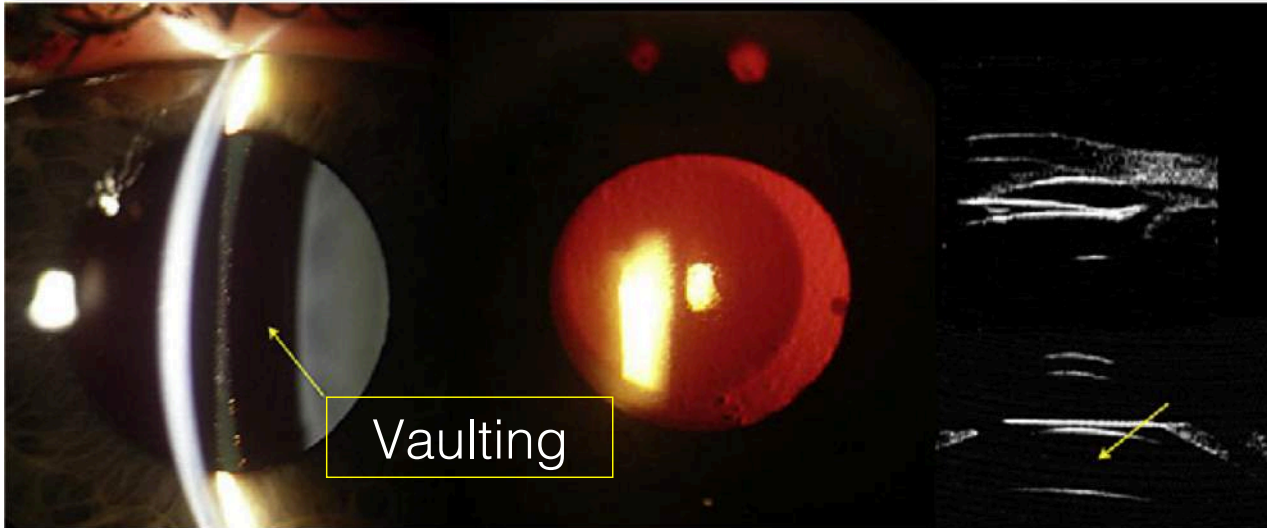
# GLAUCOMA



**Figure 1.** Visante anterior segment optical coherence tomography of the **A)** right and **B)** left eyes. Both eyes show extreme vaulting of the Implantable Collamer Lens (ICL). Note the lack of space between the iris and ICL (arrows) and the posterior position of the crystalline lens. Angle closure is 360°.

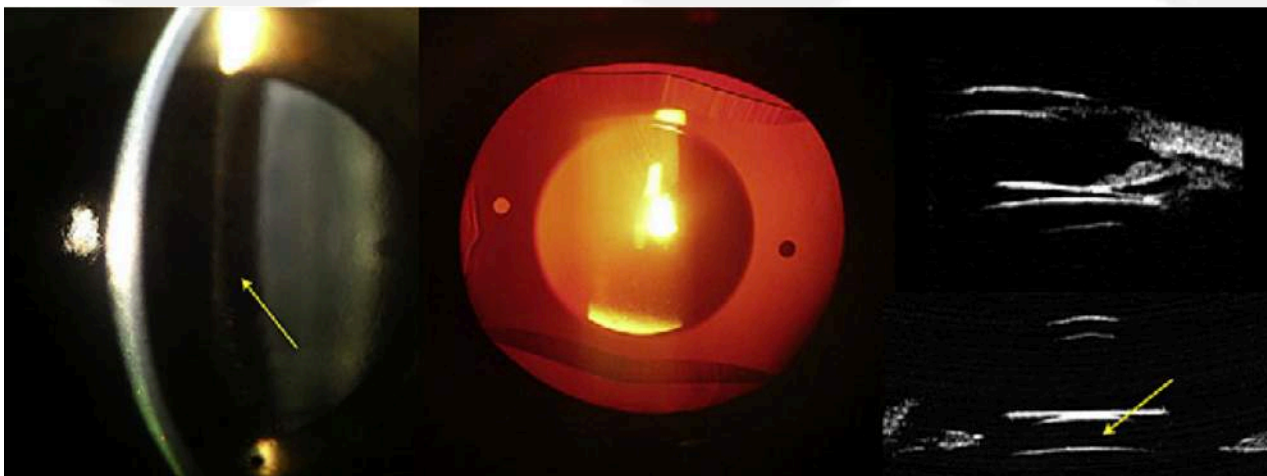
Khalifa YM, et al. Bilateral explantation of Visian Implantable Collamer Lenses secondary to bilateral acute angle closure resulting from a non-pupillary block mechanism. *J Refract Surg* 2010;26:991-994.

# GLAUCOMA



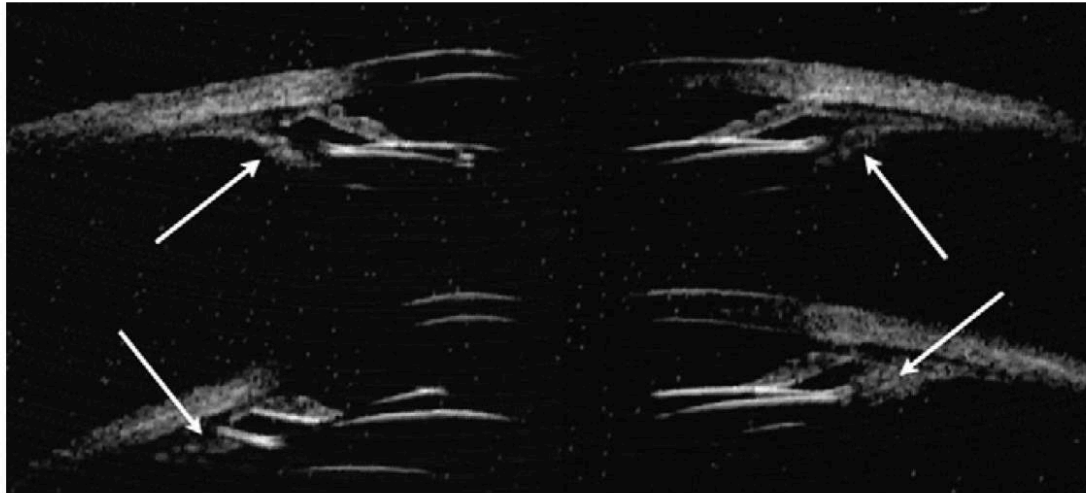
9 gg postop  
IOP = 61mmHg  
CA bassa + Vaulting elevato  
Iridotomie pervie

No riduzione IOP con  
pilocarpina, acetazolamide  
e.v. e colliri ipotonizzanti  
No miglioramento con  
iridectomia



Miglioramento con Ciclolux  
IOP = 12mmHg  
Vaulting ridotto

# GLAUCOMA



**Figure 4.** Ultrasound biomicroscopic images (*left: nasal aspect; right: temporal aspect*) of the affected eye following surgical PI demonstrating the placement of ICL haptics on prominent ciliary processes with unusual, highly variable circumferential configurations (*white arrows*). Note the anterior displacement of the ICL optic beyond the pupil edge (*bottom left*) despite haptic placement within the sulcus in this meridian.

UBM: Processi ciliari prominenti

Soluzione espianto ICL originale (13.5mm) ed impianto ICL più piccola (13mm)

## CASE REPORT

### Acute angle closure after implantable contact lens insertion unresponsive to surgical peripheral iridectomy

Kenneth C.Y. Chan, MBChB, Wayne Birchall, MB, BChir, FRANZCO, Trevor B. Gray, MBChB, FRANZCO, Anthony P. Wells, MBChB, FRANZCO

We present a case of acute angle closure that occurred after insertion of an implantable contact lens (ICL). The apparent pupillary-block angle closure did not resolve after 2 patent iridectomies and a surgical iridectomy, but did respond to pupil dilation (not constriction). Ultrasound biomicroscopy revealed abnormally large and irregular ciliary processes that may have contributed to the unusual behavior of the ICL-iris complex. The condition resolved after the ICL was replaced by one with a smaller haptic diameter. Routine ultrasound biomicroscopic assessment of the ciliary body anatomy preoperatively and ICL haptic positioning postoperatively may identify risk factors that could predispose ICL patients to acute angle closure.

*J Cataract Refract Surg* 2008; 34:696-699 © 2008 ASCRS and ESCRS

# GLAUCOMA

Glaucoma da dispersione di pigmento

- ✓ Causato da sfregamento ICL su faccia posteriore iride o da iridotomia
- ✓ Rimozione/sostituzione/rotazione dell'ICL



# ALONI

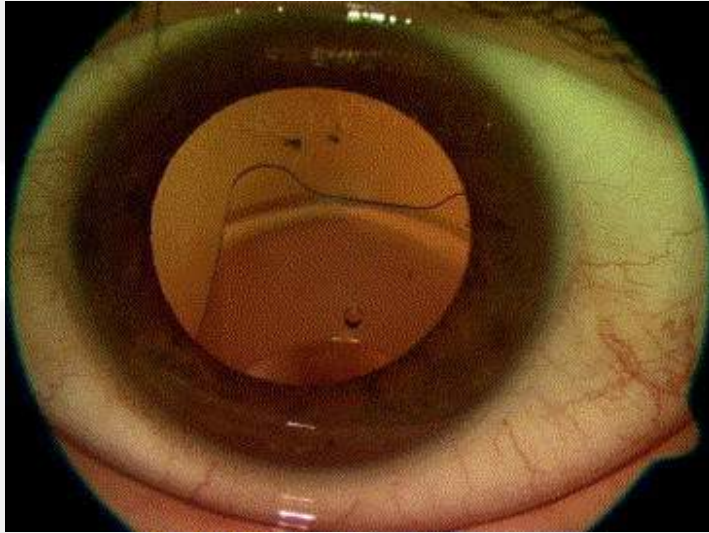
- ✓ Estremamente rari (pupille <6mm)
- ✓ No differenza fra ICL con e senza foro

# PERDITA CELLULE ENDOTELIALI

- ✓ Perdita del 3% ogni anno per i primi 3 anni, con successiva stabilizzazione (Edelhauser et al JCRS 2004)
- ✓ Dati FDA
  - ✓ Perdita 8.9% a 3 aa
  - ✓ Perdita 10.6% a 4 aa

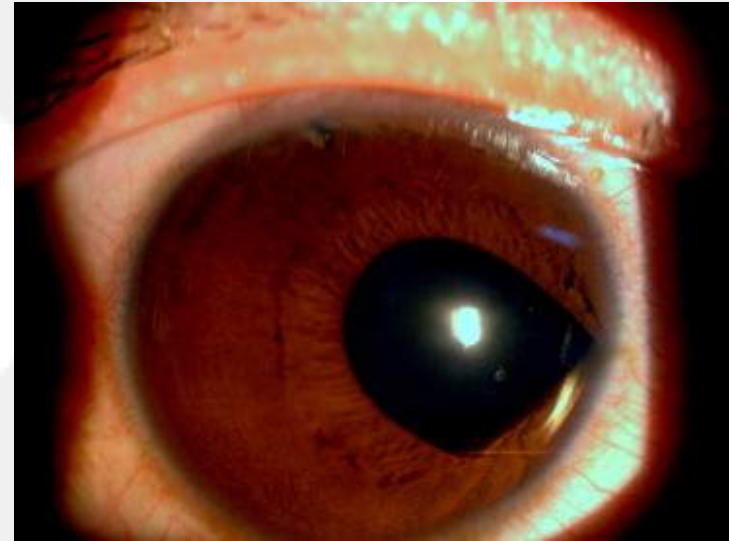
Years from procedure	Predicted Percent Cell Loss	90% prediction interval	
		Lower	Upper
3 months	3%	-18%	24%
1	5%	-17%	26%
2	7%	-15%	28%
3	9%	-13%	30%
4	11%	-11%	32%
5	13%	-9%	34%
10	23%	1%	45%
15	34%	11%	56%
20	44%	20%	68%
25	54%	29%	80%
30	65%	38%	92%
35	75%	46%	100%
40	85%	54%	100%
45	96%	63%	100%
50	100%	71%	100%
55	100%	79%	100%
60	100%	86%	100%

# DISLOCAZIONE



Spontaneo

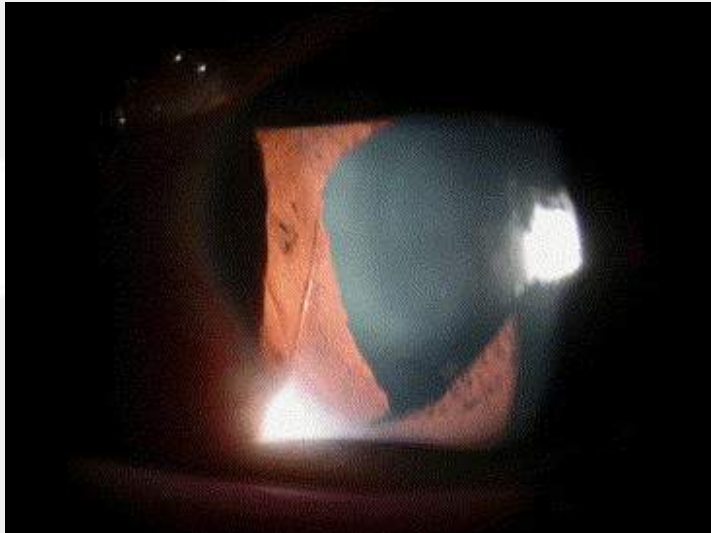
Kauefer RA, et al. JCRS 2005;31:1254



Trauma occipitale

Kong J, et al. Ophthalmology 2010;117:399

# DISLOCAZIONE



Trauma contusivo

Song JS, et al. JCRS 2005;31:1831



Trauma contusivo

Morshirfar M, et al. Open Ophthalmol J  
2014;8:24

# ENDOFTALMITE

Possibile come in ogni procedura  
intraoculare

✓ Incidenza 1:6000 (Allan et al. JCRS 2009)

# COMPLICANZE

Cosa succede se si impianta ICL in occhi con ACD <2.8 mm?

- ✓ Stessi risultati visivi
- ✓ No differenze per cellule endoteliali
- ✓ No casi di ipertono o dispersione pigmento
- ✓ Vaulting <250µm nel 44% dei casi
- ✓ Cataratta sottocapsulare anteriore nell'11% dei casi (chirurgia nel 5.5%) in pz con età ≥45 aa

Lim DH, et al. Clinical results of posterior chamber phakic intraocular lens implantation in eyes with low anterior chamber depth. AJO 2014;158:447-454.

# FUTURO

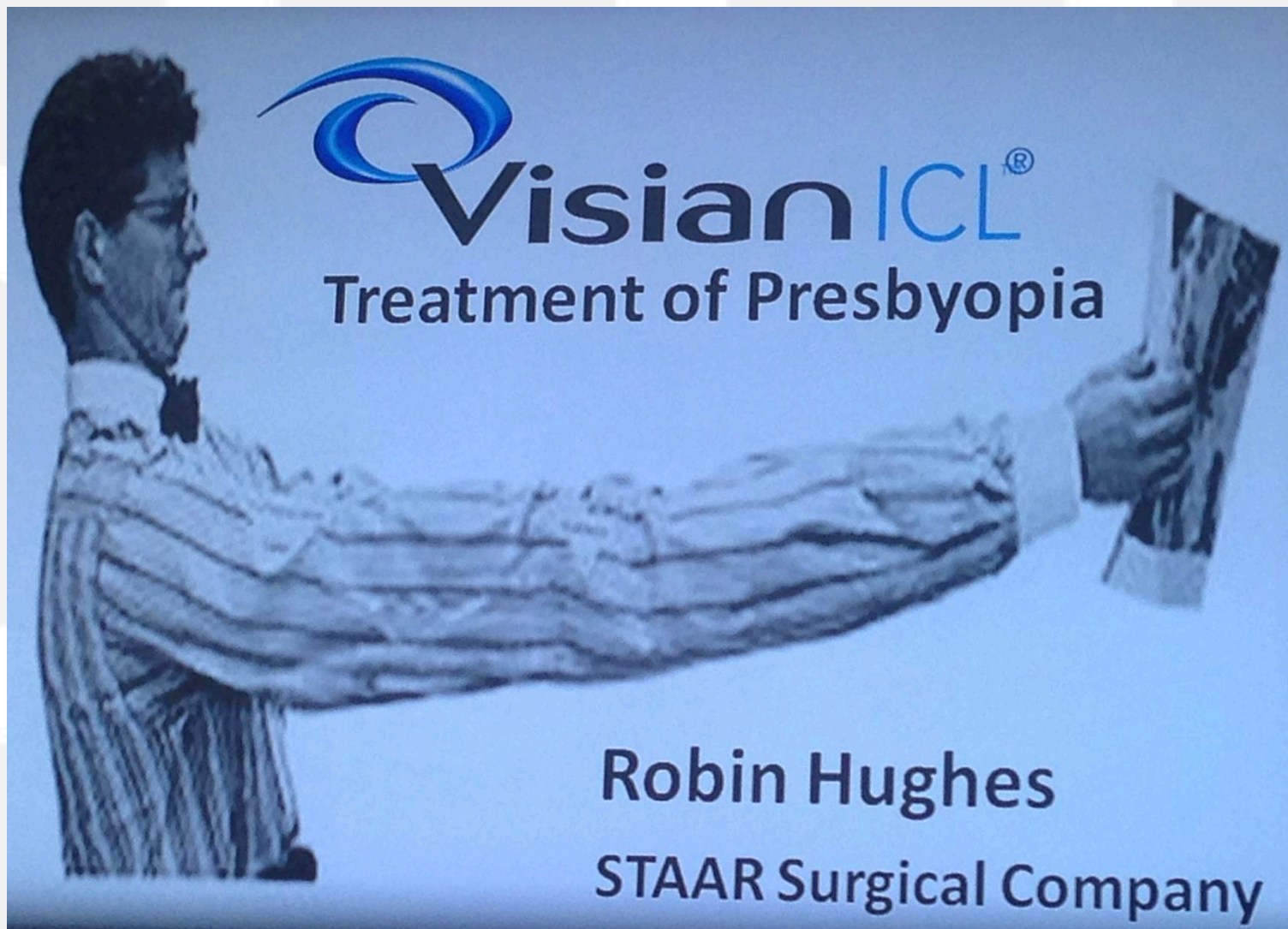
## **STAAR,** **ICL V5 pre cargado**

**Menor riesgo de ruptura al cargar el cartridge**

**Menor tiempo quirúrgico**



# FUTURO

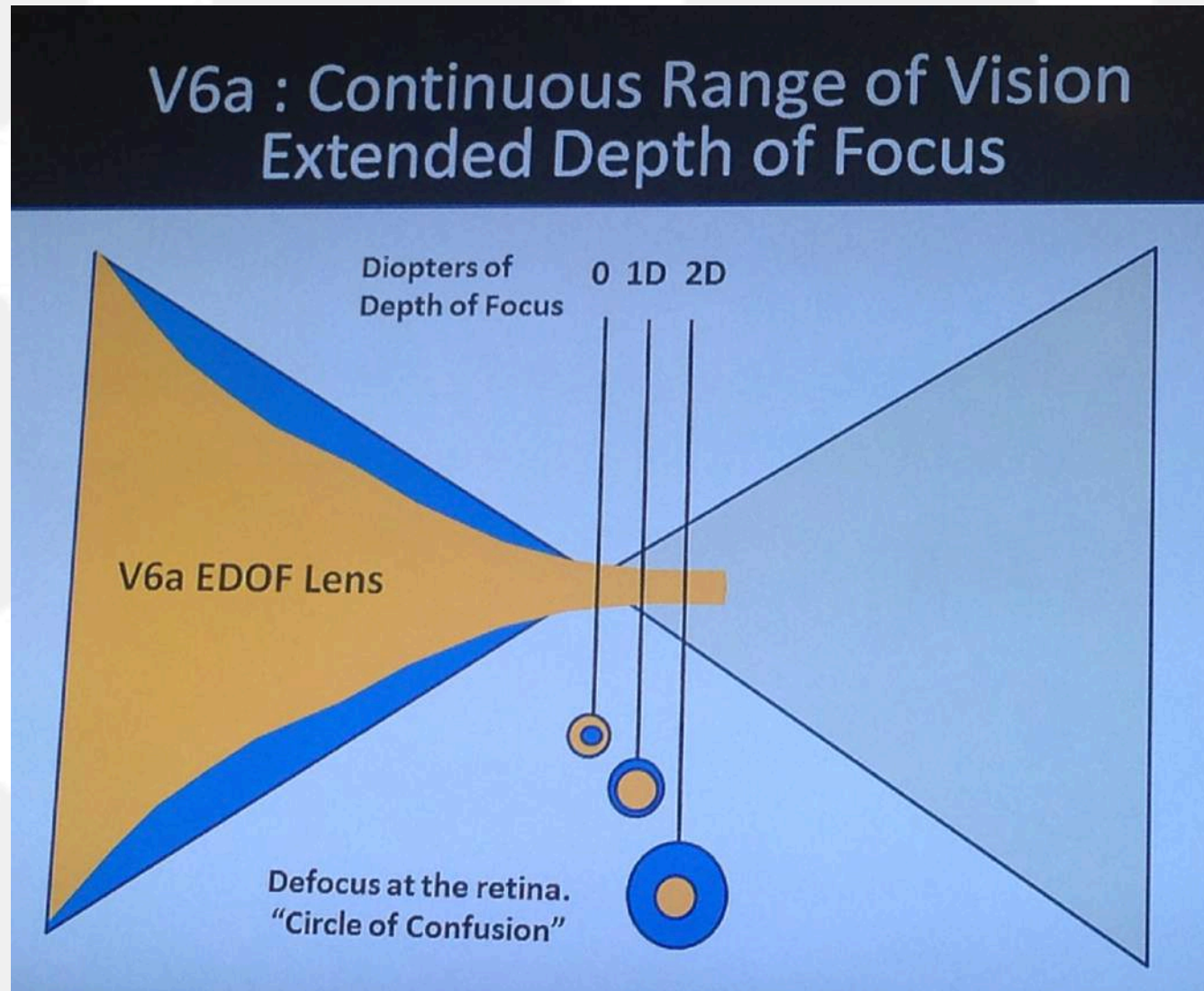
A man in a suit and glasses is shown in profile, reading a newspaper. The background is a solid blue color. The text "Vision ICL" is written in a stylized font, with "Vision" in black and "ICL" in blue. Below it, "Treatment of Presbyopia" is written in black. At the bottom right, the name "Robin Hughes" and "STAAR Surgical Company" are listed in black.

**Vision ICL<sup>®</sup>**  
Treatment of Presbyopia

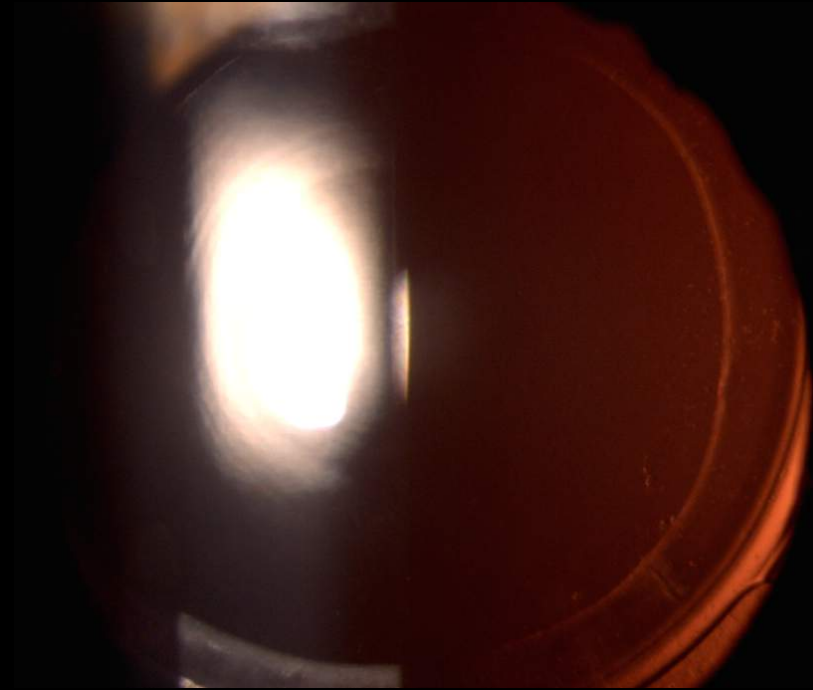
**Robin Hughes**  
STAAR Surgical Company



# FUTURO



# Novità nelle Lenti Multifocali



Giacomo Savini

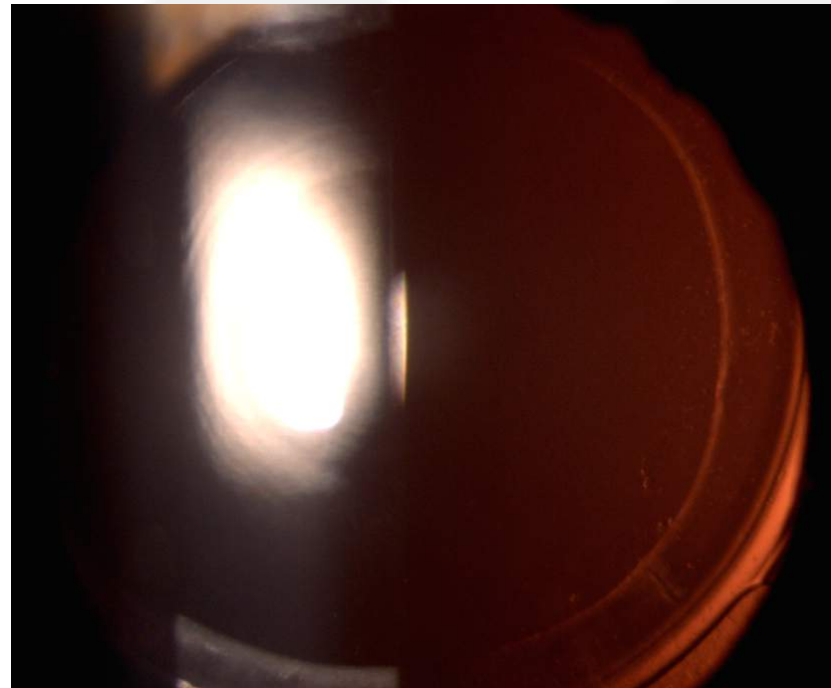
Studio Oculistico d'Azeglio – Bologna  
Fondazione GB Bietti IRCCS – Roma



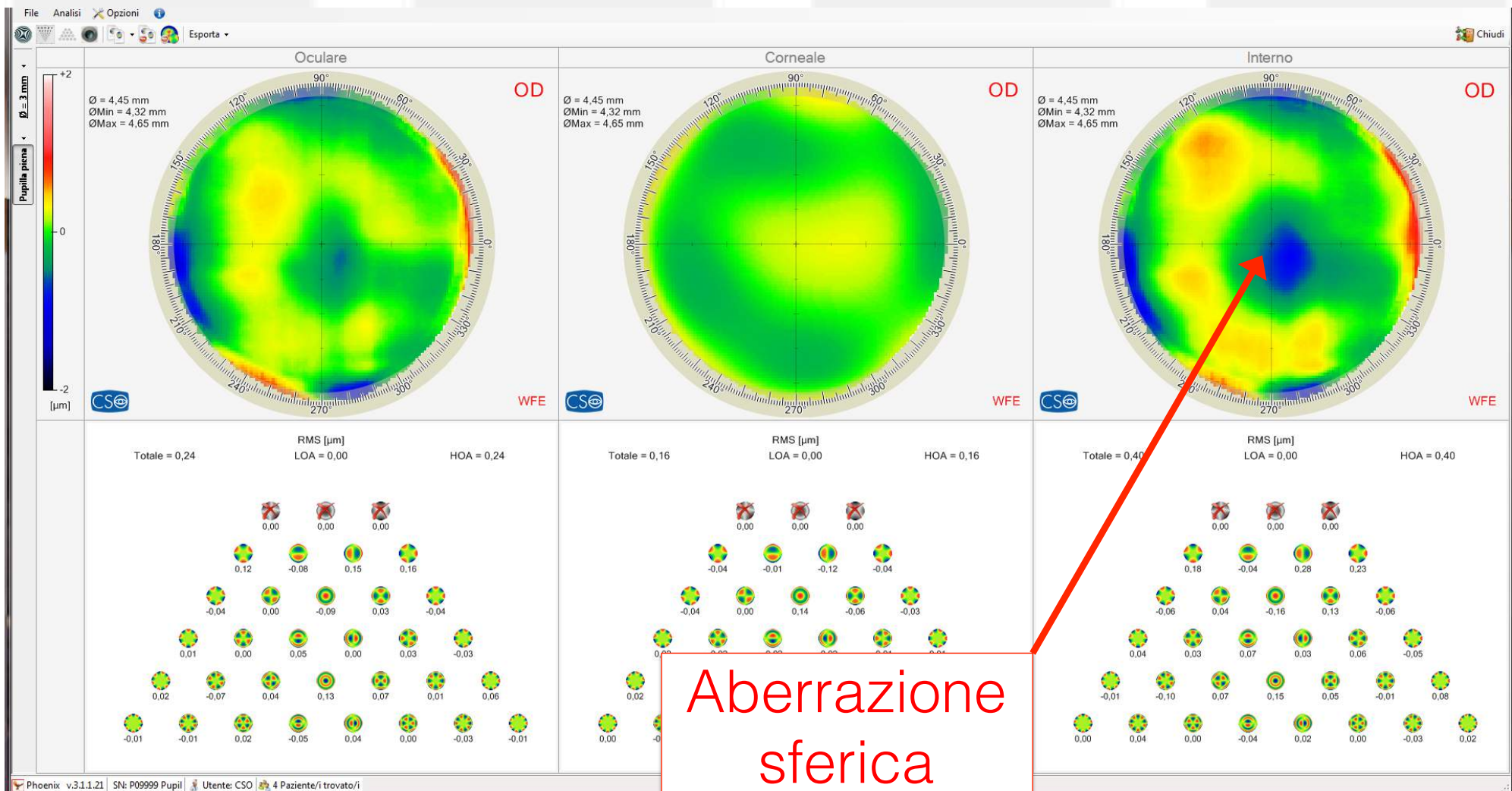
# EXTENDED DEPTH OF FOCUS

SIFI Miniwell

- ✓ Induzione di aberrazione sferica negativa



# EXTENDED DEPTH OF FOCUS



# EXTENDED DEPTH OF FOCUS

## Tecnis Symphony

- ✓ Ottimizzazione visione intermedia

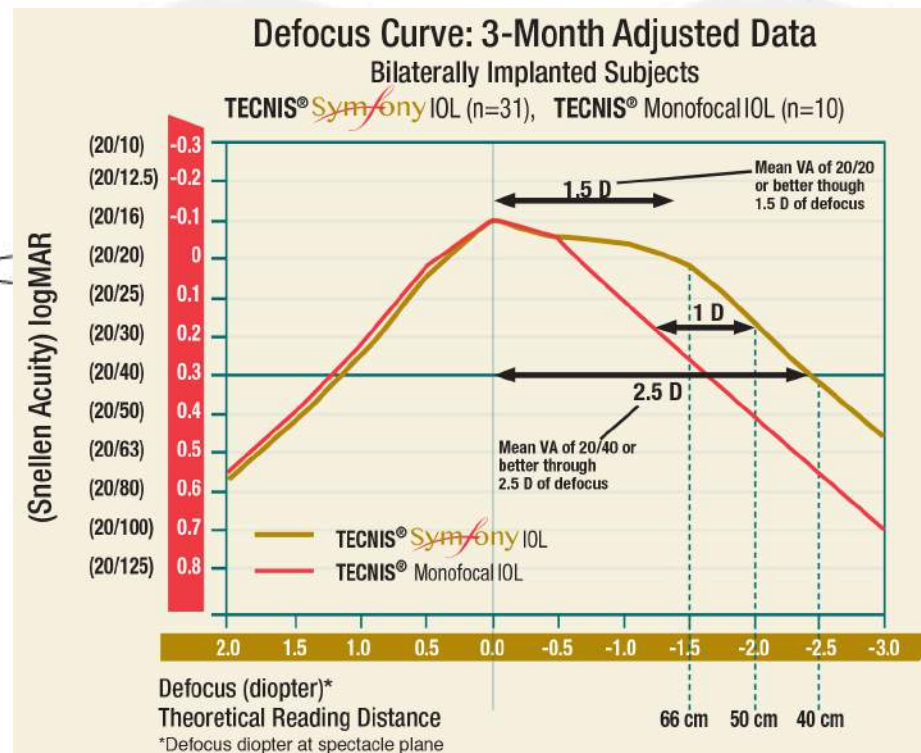
TECNIS<sup>®</sup>  
*Symphony*  
Extended Range of Vision IOL

Echelette Side View

Light

Elongated Focus

Focal Length



# TRIFOCALI

Physiol Fine Vision

✓ Prima IOL difrattiva trifocale



# TRIFOCALI

Zeiss AT Lisa Tri

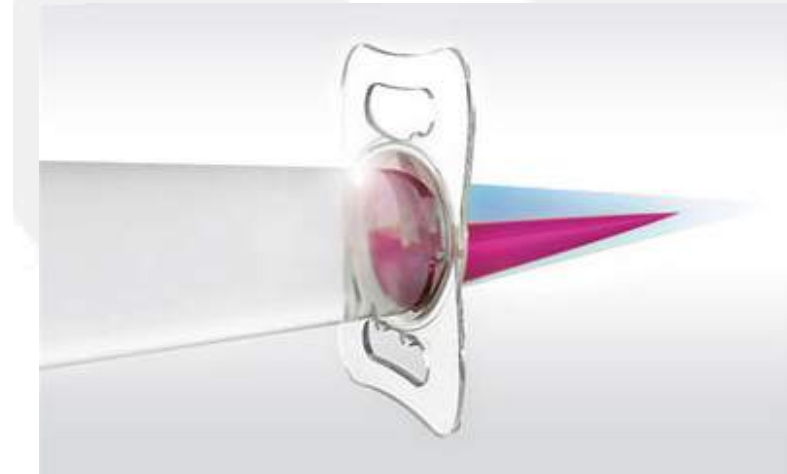
✓ Difrattiva trifocale (torica)



# CON SEGMENTO ASIMMETRICO

Oculentis Mplus (Comfort)

✓ Prima lente bifocale asimmetrica





# CON SEGMENTO ASIMMETRICO

Nanovision Hoffer Multifocal IOL

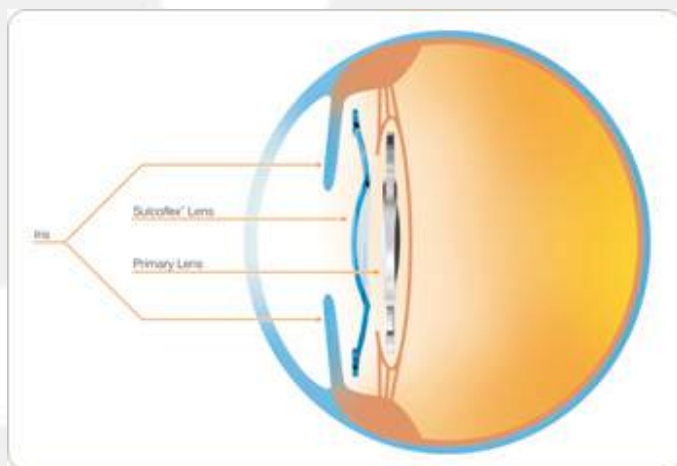
✓ Prima lente bifocale asimmetrica



# PIGGY BACK

Rayner Sulcoflex

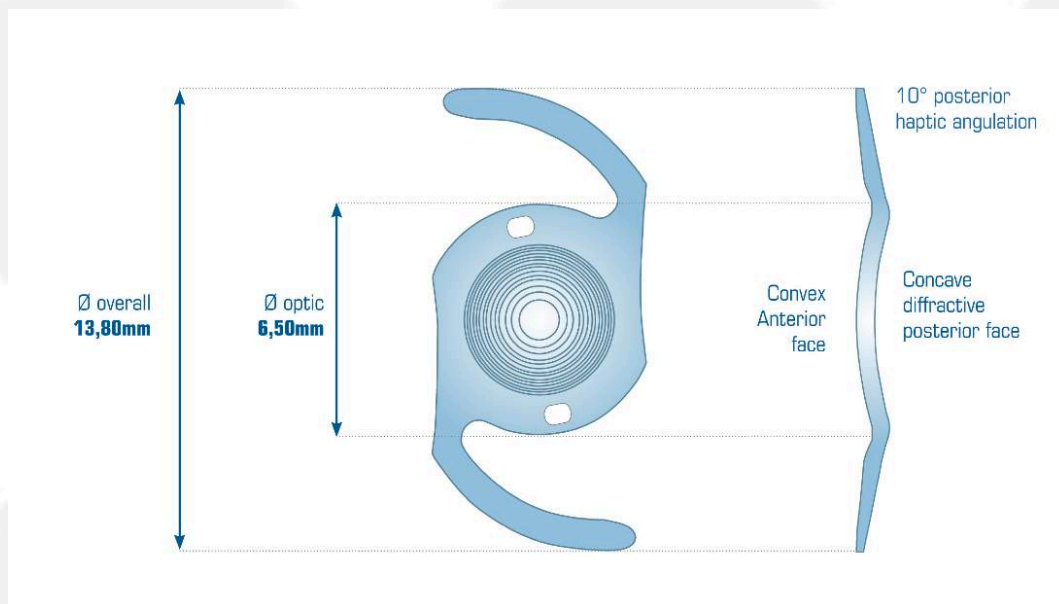
✓ Prima lente multifocale per occhi pseudo-fachici



# PIGGY BACK

Cristalens Reverso

✓ Prima alternativa alla Sulcoflex



# VALUTAZIONE PROSPETTICA

Dati preoperatori

- ✓ Cheratometria, ACD, lunghezza assiale
- ✓ Angolo K
- ✓ Asfericità corneale
- ✓ Diametro pupillare

# VALUTAZIONE PROSPETTICA

Dati postoperatori

- ✓ Acuità visiva
- ✓ Curve di defocus
- ✓ Sensibilità al contrasto
- ✓ Velocità di lettura (tavole di Radner)
- ✓ Alometria

# Per scaricare il pdf del corso

STUDIO OCULISTICO D'AZEGLIO  
Via d'Azeglio 5, Bologna - Tel. 051-6493203 - info@studiodazeglio.it

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LA TECNOLOGIA AL SERVIZIO DELLA DIAGNOSTICA

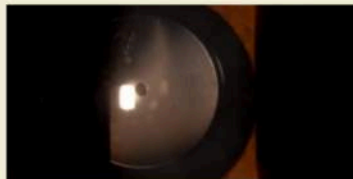
The screenshot shows a website for 'STUDIO OCULISTICO D'AZEGLIO'. The header includes the studio's name, address (Via d'Azeglio 5, Bologna), phone number (051-6493203), and email (info@studiodazeglio.it). There are social media icons for Facebook, RSS, and YouTube. A navigation menu contains links for Home, Chi Siamo, Info Pazienti, Ricerca Medica (highlighted in red), Dove Siamo, Assicurazioni, and Art. A dropdown menu under 'Ricerca Medica' lists 'Publicazioni', 'Corsi' (highlighted in blue), and 'Presentazioni'. A red arrow points from the 'Corsi' link to a large banner image. The banner features a blue-toned fundus photograph on the left and a blue-toned retinal pattern on the right, with the text 'LA TECNOLOGIA AL SERVIZIO DELLA DIAGNOSTICA' overlaid. Below the banner are three smaller images: a fundus image with overlaid data, a clinical examination room with two patients, and a close-up of an ophthalmic instrument.

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## CHIRURGIA



- FemtoLASIK e PRK
- Cataratta
- ICL: Lenti facheche
- Vitreoretina
- Glaucoma
- Cross Linking

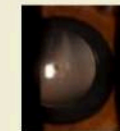
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## CATARATTA - 10 MOTIVI PER SCEGLIERCI



## CORSI

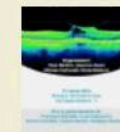
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