

Biomateriali in Oftalmologia

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Azienda Universitaria Ospedaliera Pisana

Anatomia dell' occhio

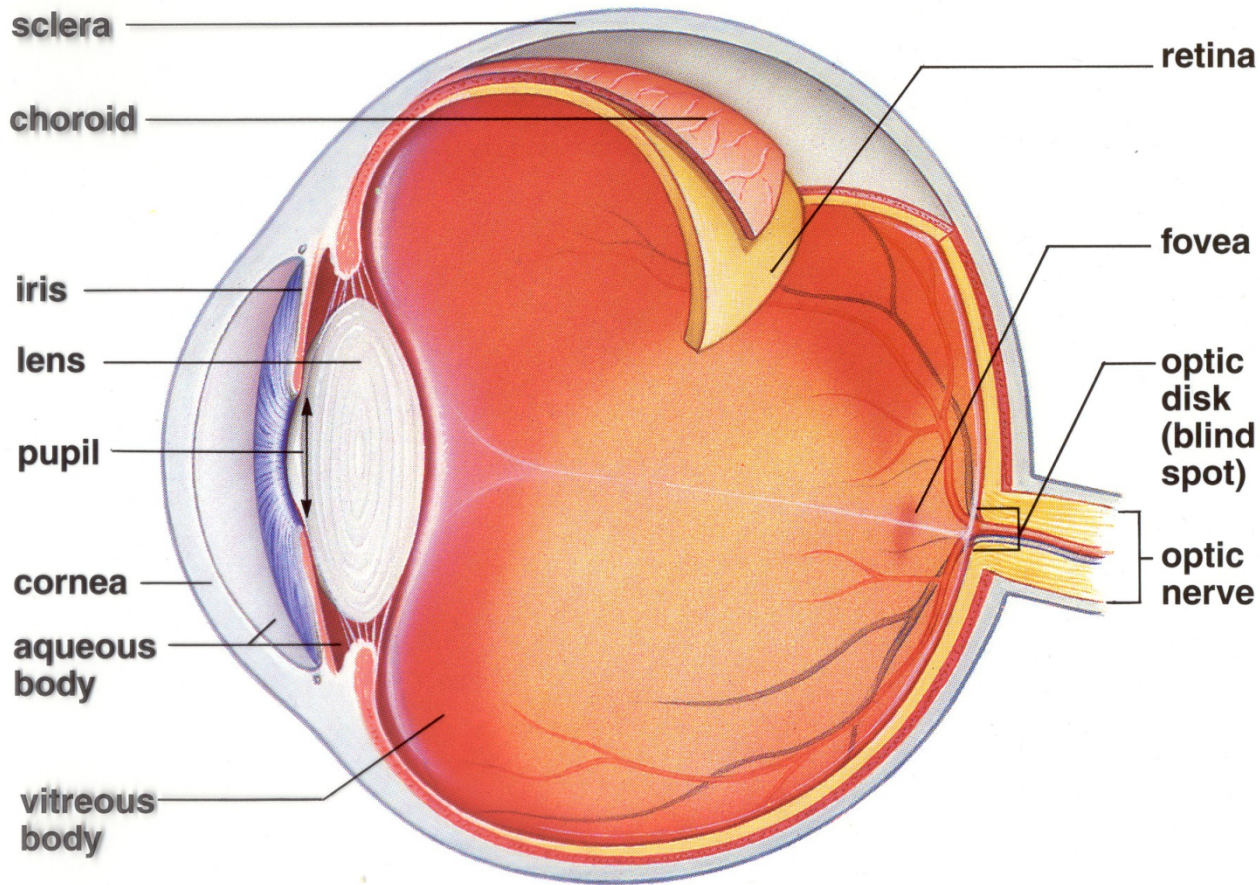
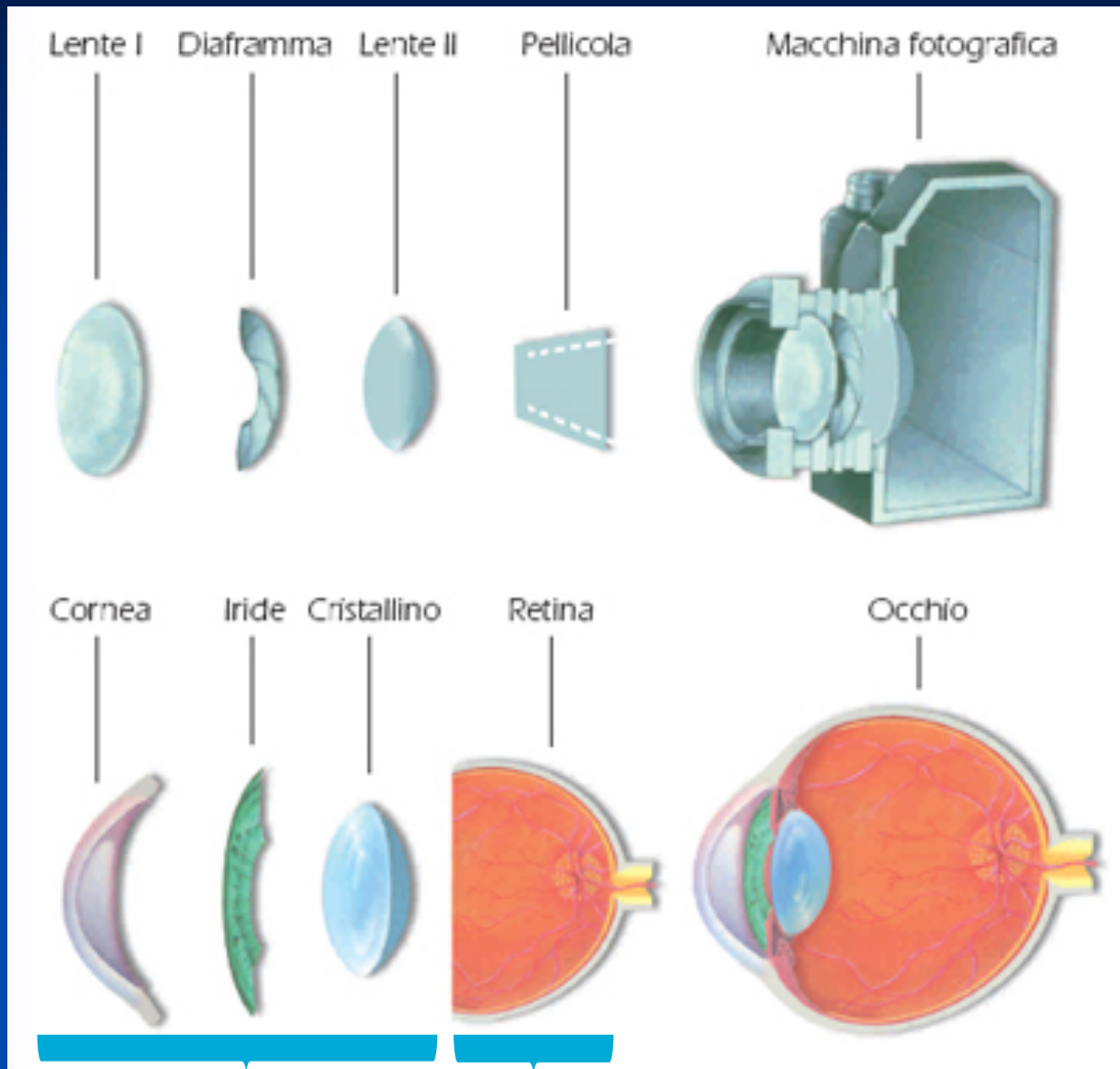


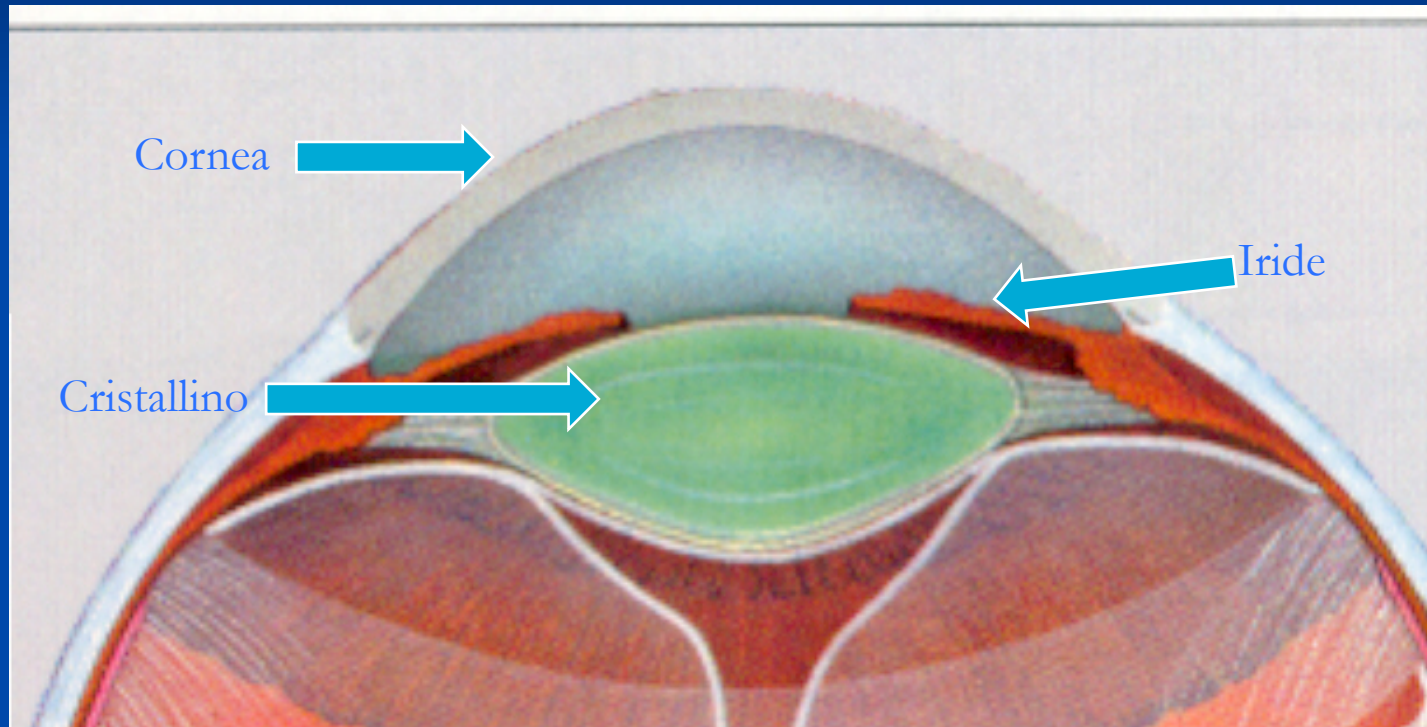
Fig. 32.30 Structure of the human eye.



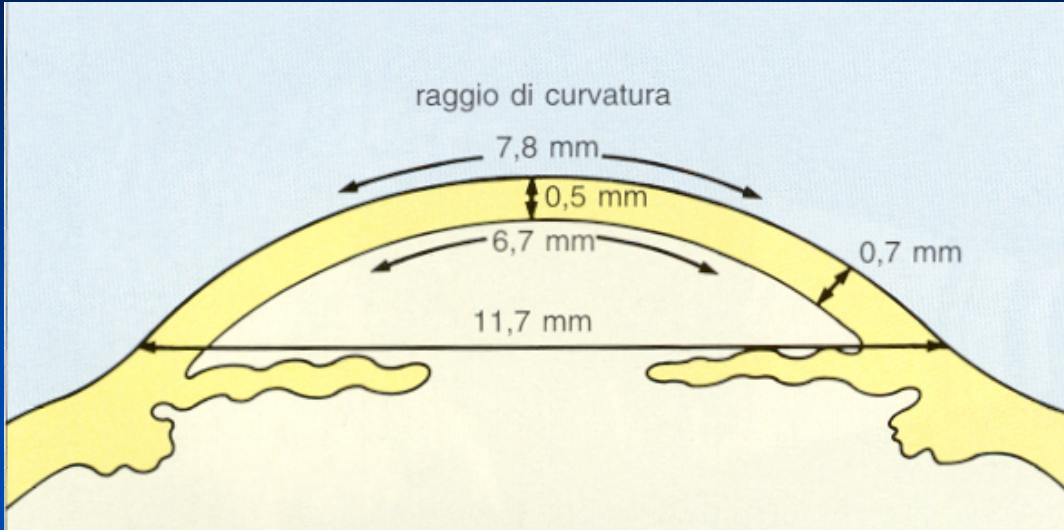
Segmento anteriore

Segmento posteriore

Segmento anteriore

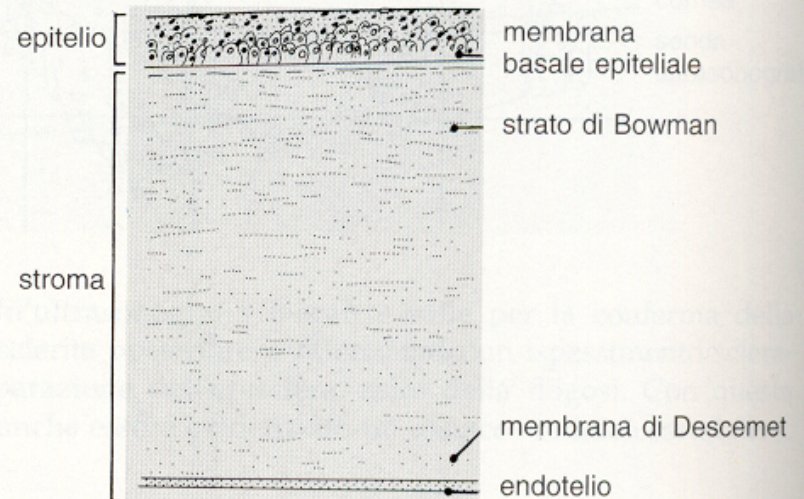


Cornea

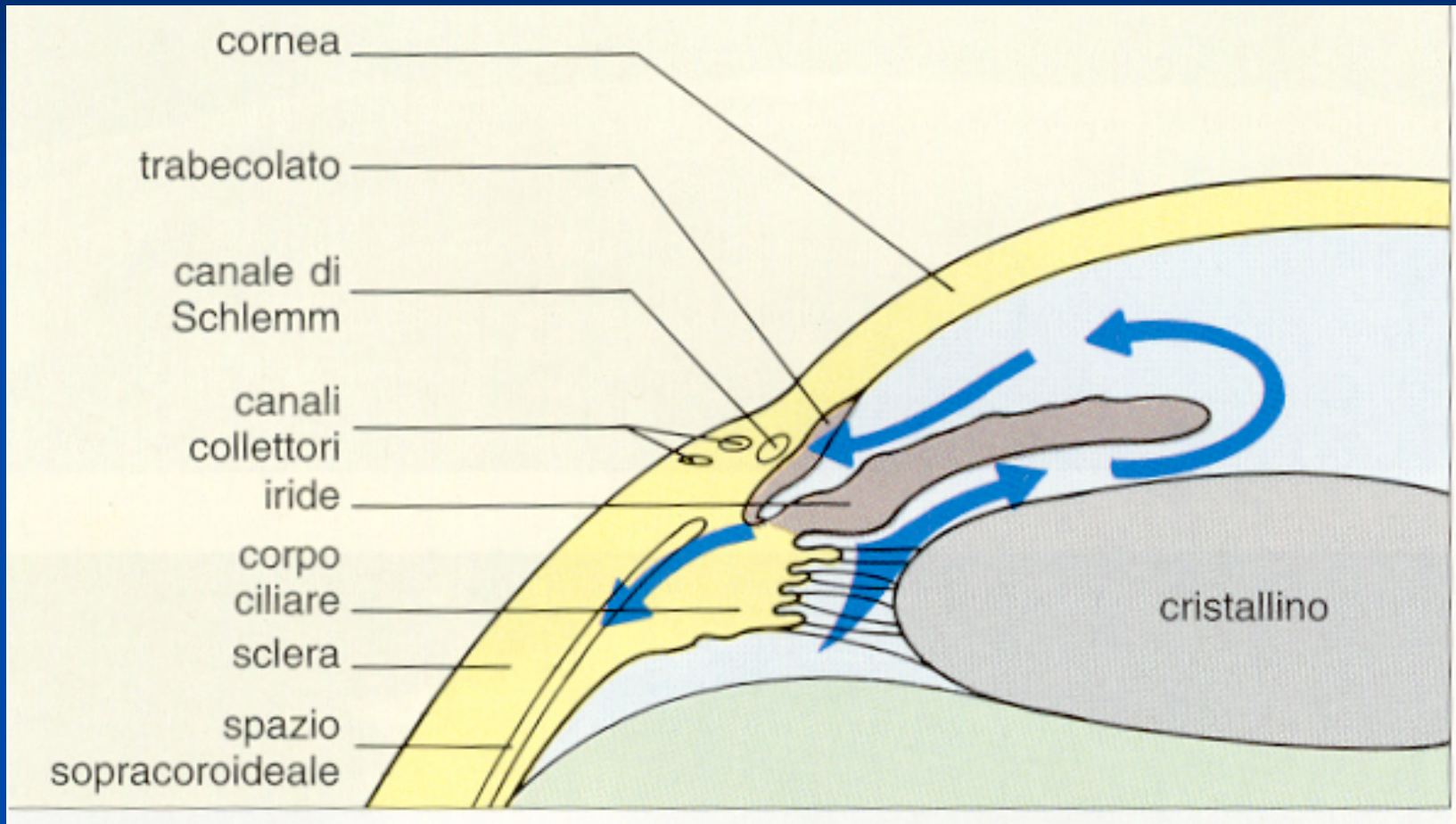


Potere diottrico

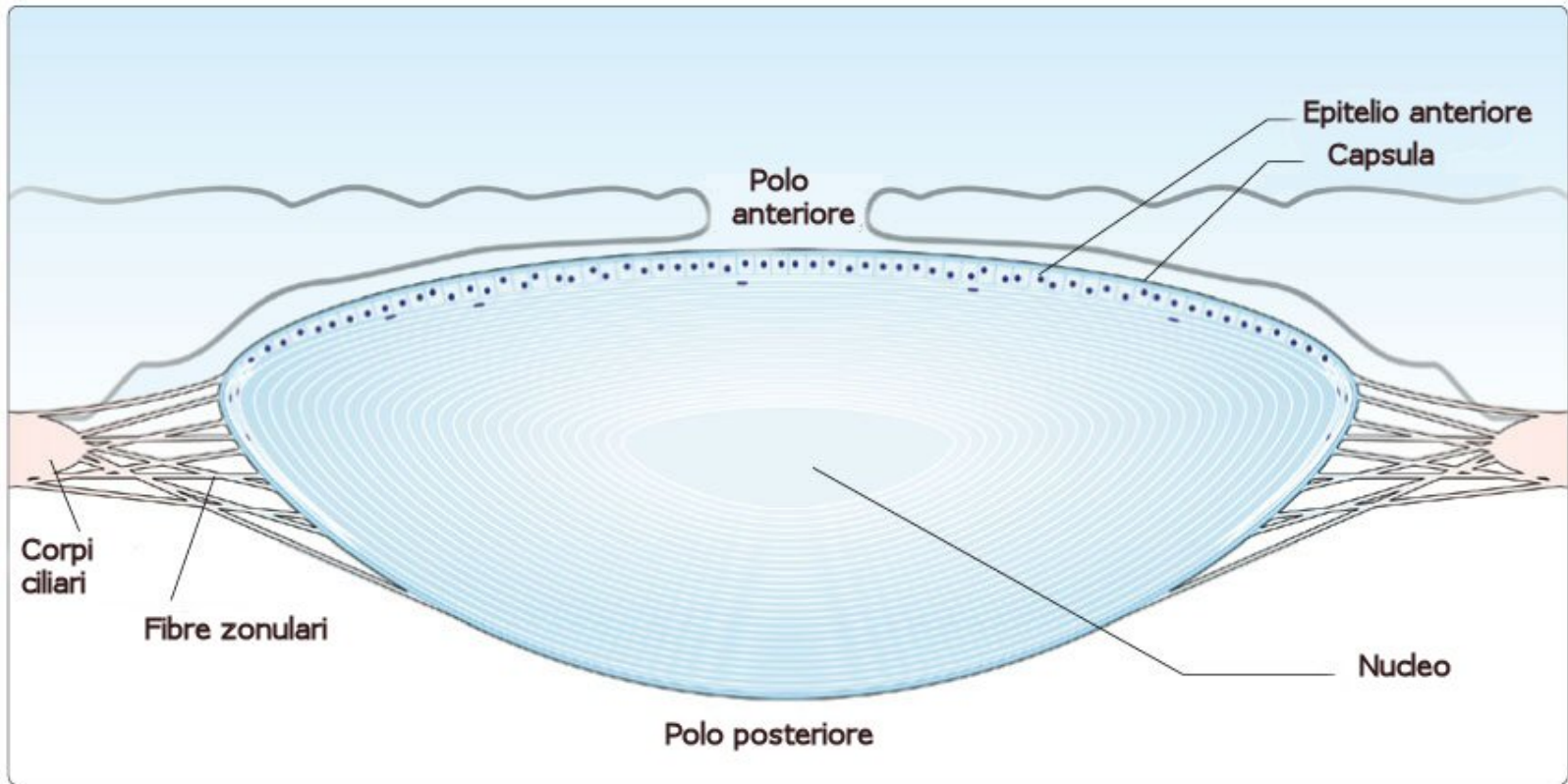
Circa +42 D



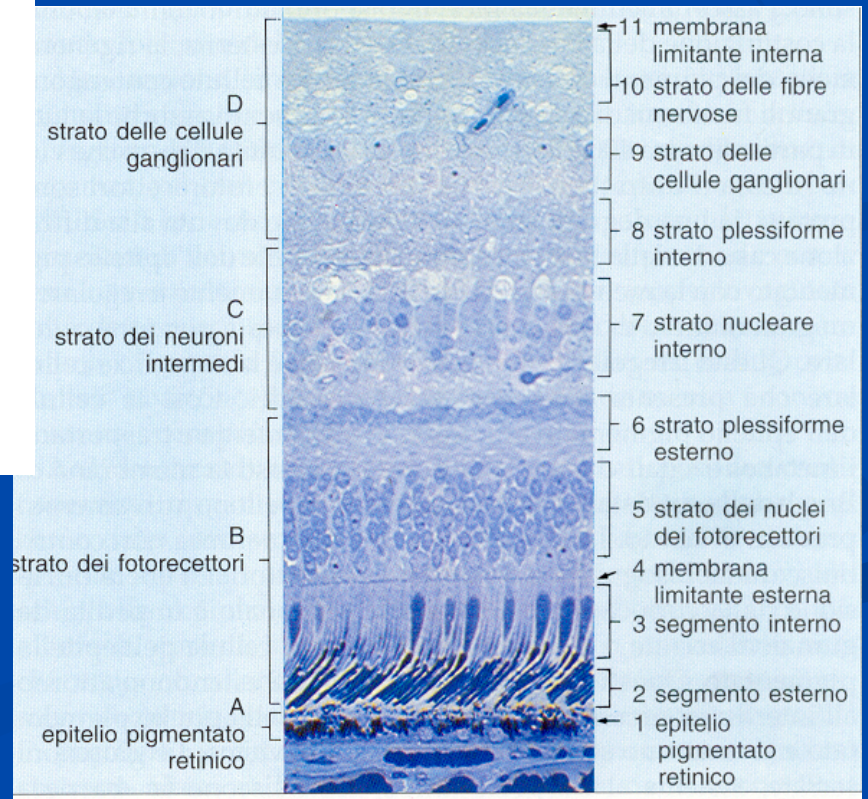
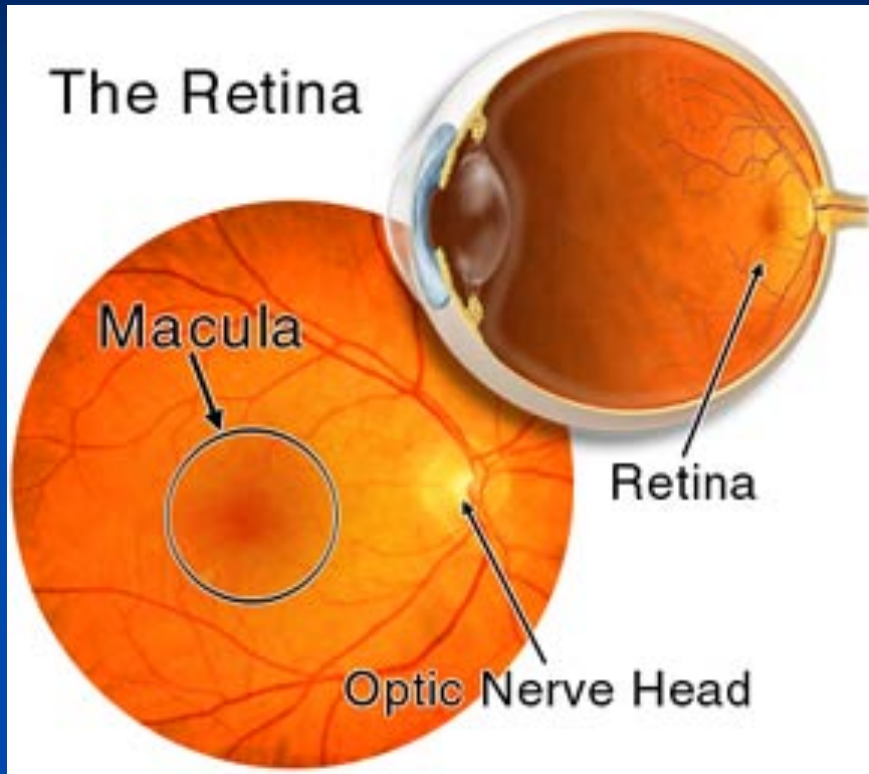
Angolo



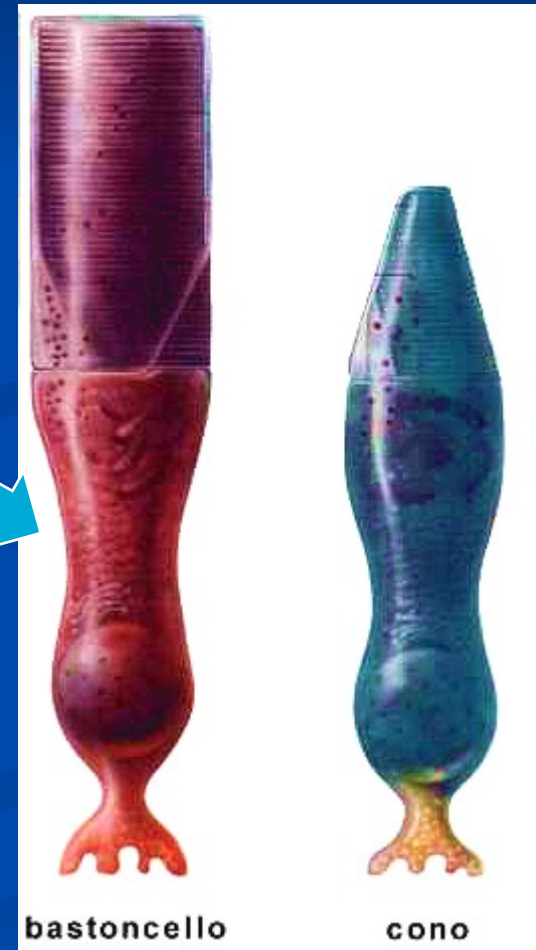
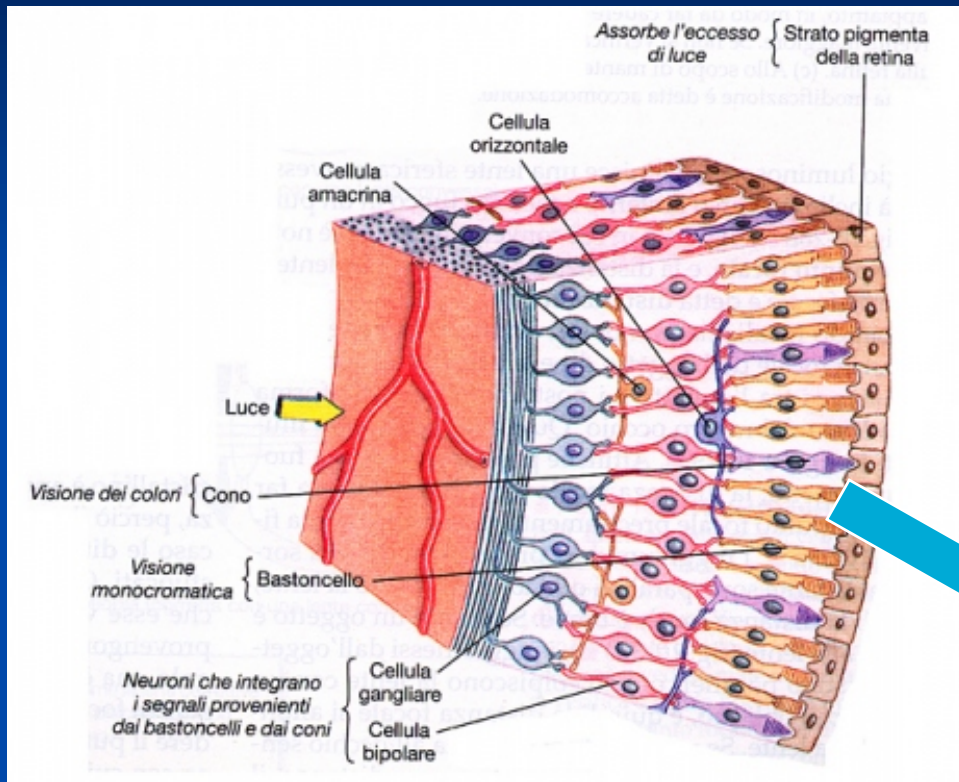
Lente (+19 - +33 D)



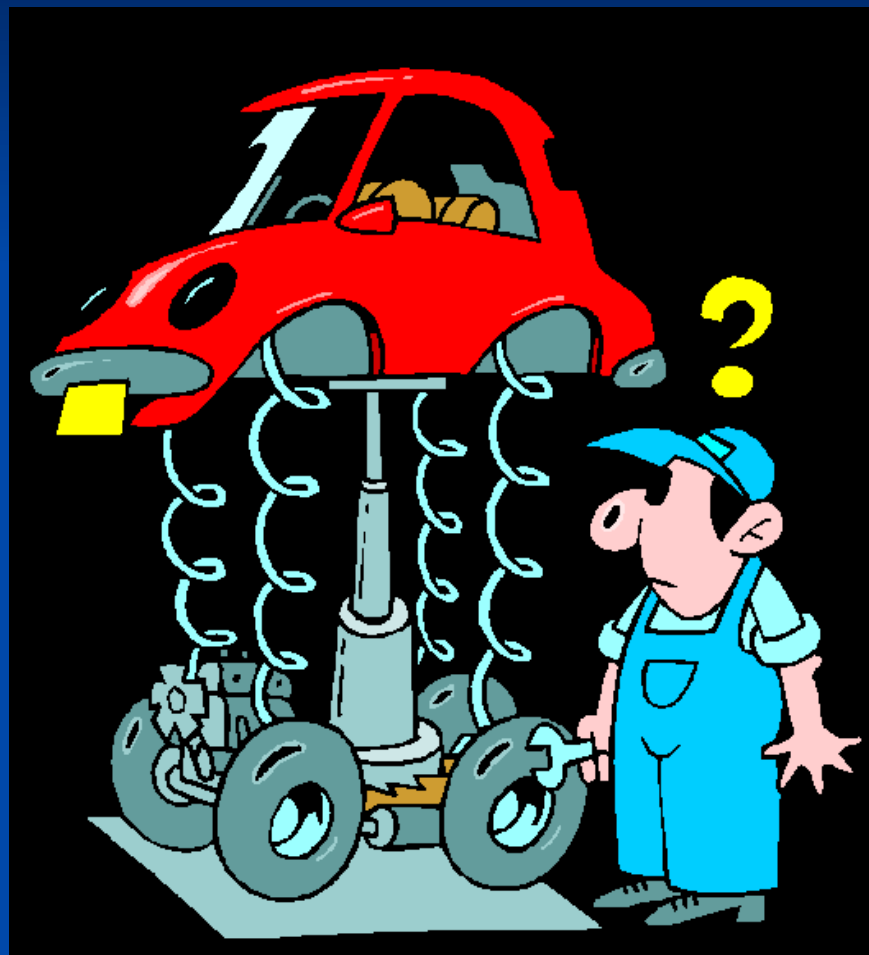
Retina



Retina

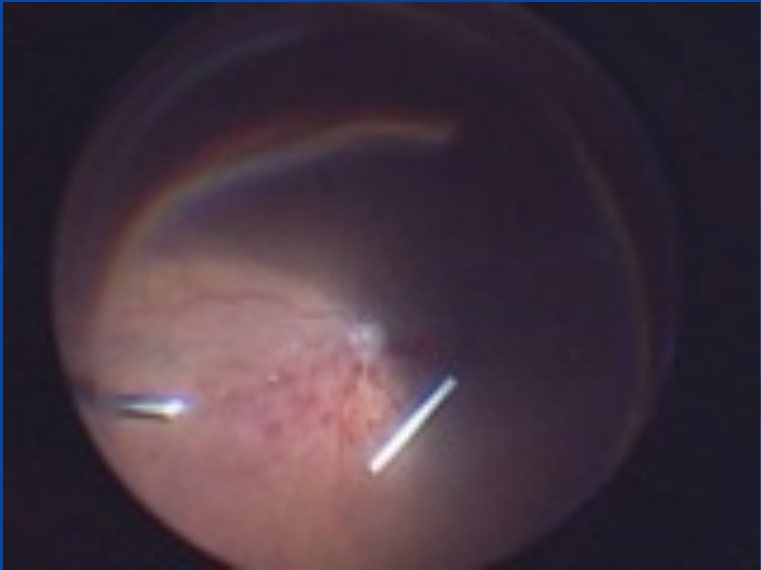
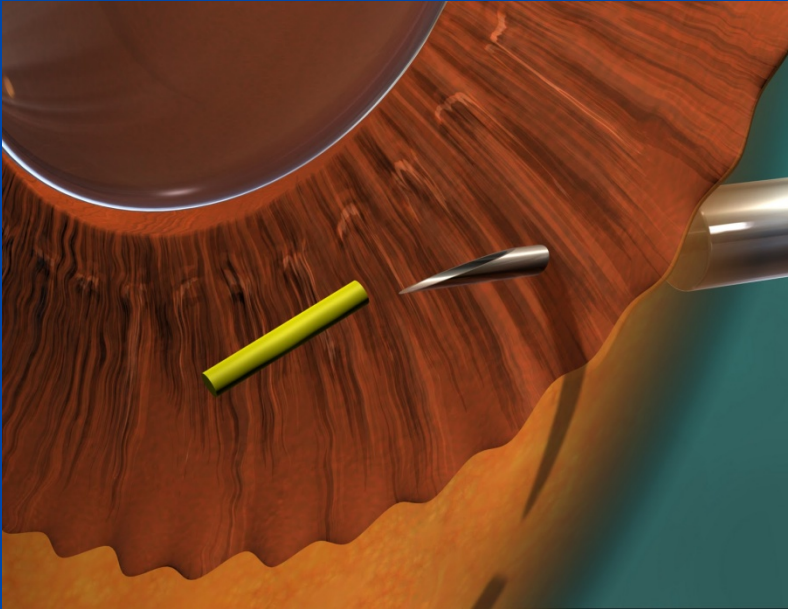


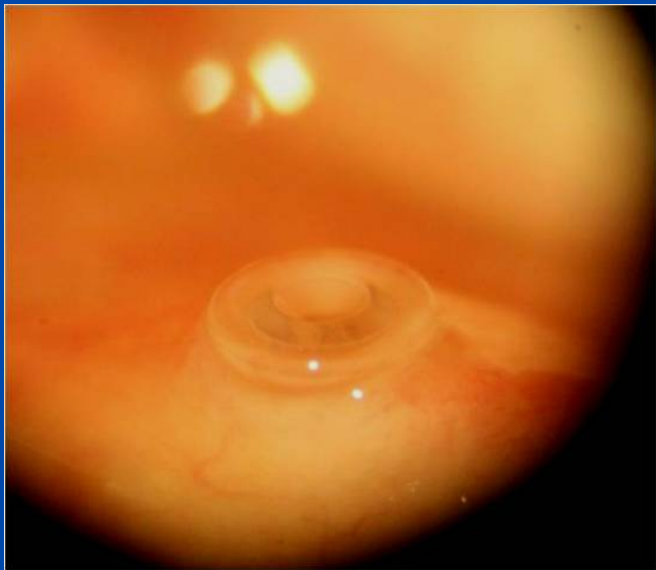
Se si rompe qualcosa ???

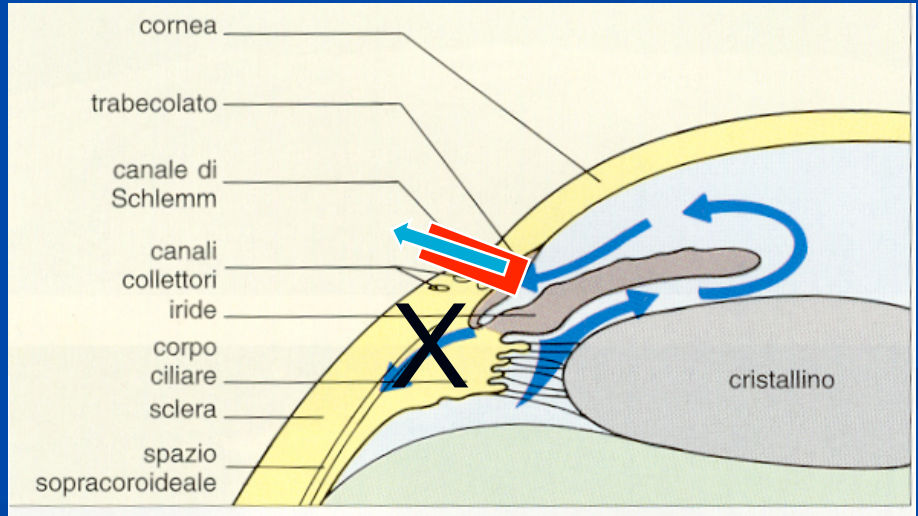
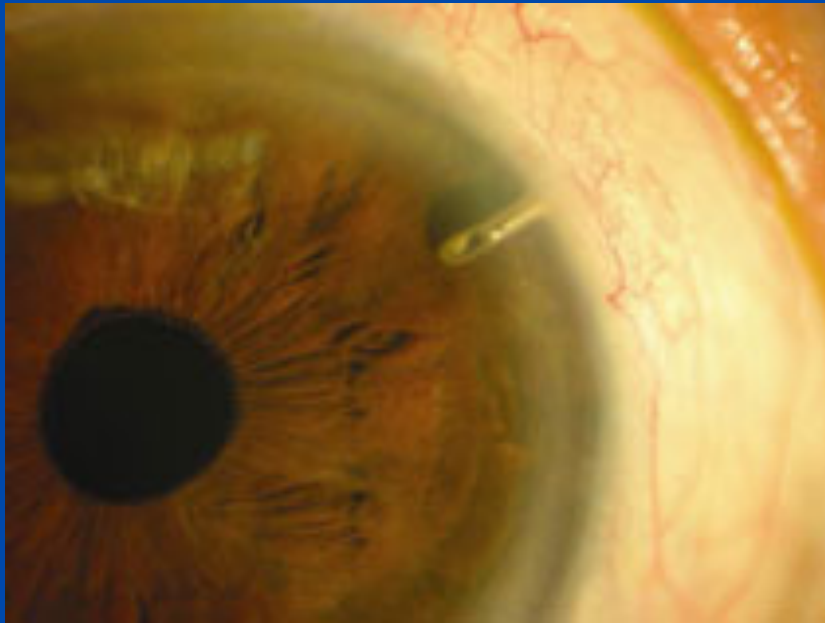
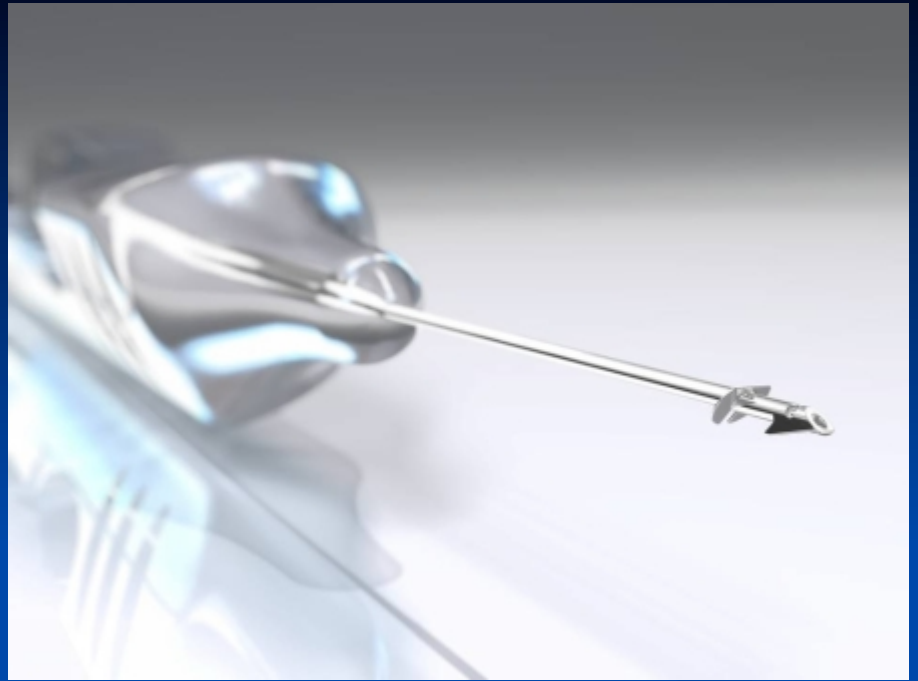
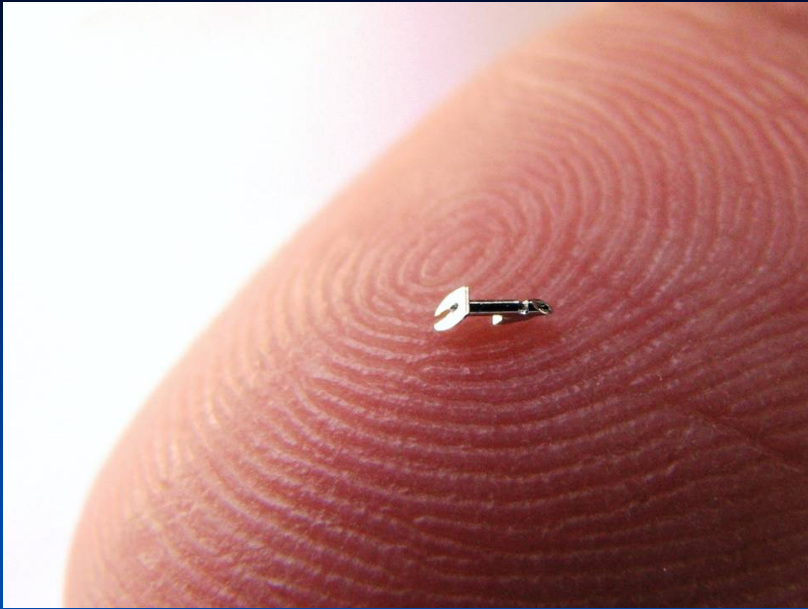


Applications sites for biomaterials in Ophthalmology

- Contact lenses, drug delivery systems, artificial cornea, lachrymal canalicular repair
- Conduits for aqueous drainage in glaucoma (Valve)
- Intraocular lenses
- Artificial vitreous (Silicone)
- Artificial retina





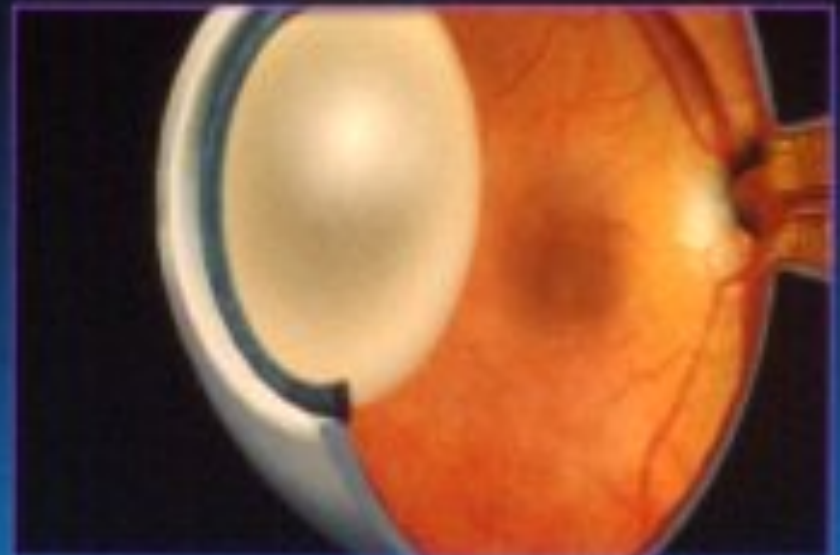
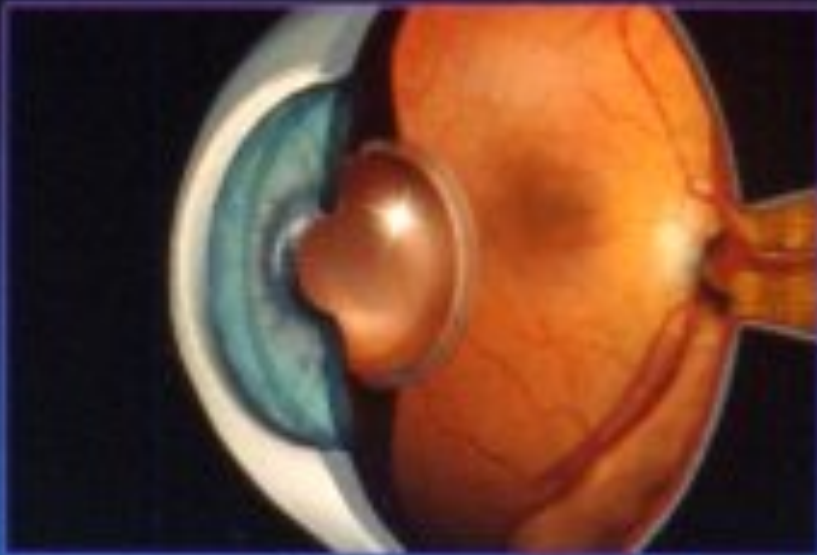


I MATERIALI delle IOL

La cataratta

Normal Lens

Cataract



Video





.....alla ricerca del MATERIALE perfetto.....

Ma esiste davvero il materiale perfetto?

**Il materiale che non altera o modifica il
metabolismo cellulare e non induce
processi degenerativi, apoptotici o
necrotici a carico delle cellule con cui
è in contatto.**

Biocompatibilità , non è solo Materiale



**acrylate/
methacrylate
polymers**

- methyl methacrylate (MMA)
- 2-phenylethyl acrylate (PEA)
- 2-phenylethyl methacrylate (PEMA)
- ethyl acrylate (EA)
- ethyl methacrylate (EMA)
- 2,2,2-trifluoroethyl methacrylate (TFEMA)
- 6-hydroxyhexyl methacrylate (HOHEXMA)
- 2-hydroxyethyl methacrylate (HEMA)

PMMA
- hydrophobic
- R.I.: 1.49 W.C.: <1%

PMMA with HSM
- hydrophobic / hydrophilic surface
- R.I.: 1.49 W.C.: <1%

Alcon AcrySof
- hydrophobic
- R.I.: 1.55 W.C.: <1%

Allergan ClariFlex
- hydrophobic
- R.I.: 1.47 W.C.: <1%

ORC MemoryLens / Morcher 92C
- hydrophilic
- R.I.: 1.47 / 1.46 W.C.: 20% / 28%

Storz Hydroview
- hydrophilic
- R.I.: 1.47 W.C.: 18%

Alcon HydroSof, Corneal ISH66
- hydrophilic
- R.I.: 1.44 W.C.: 38%

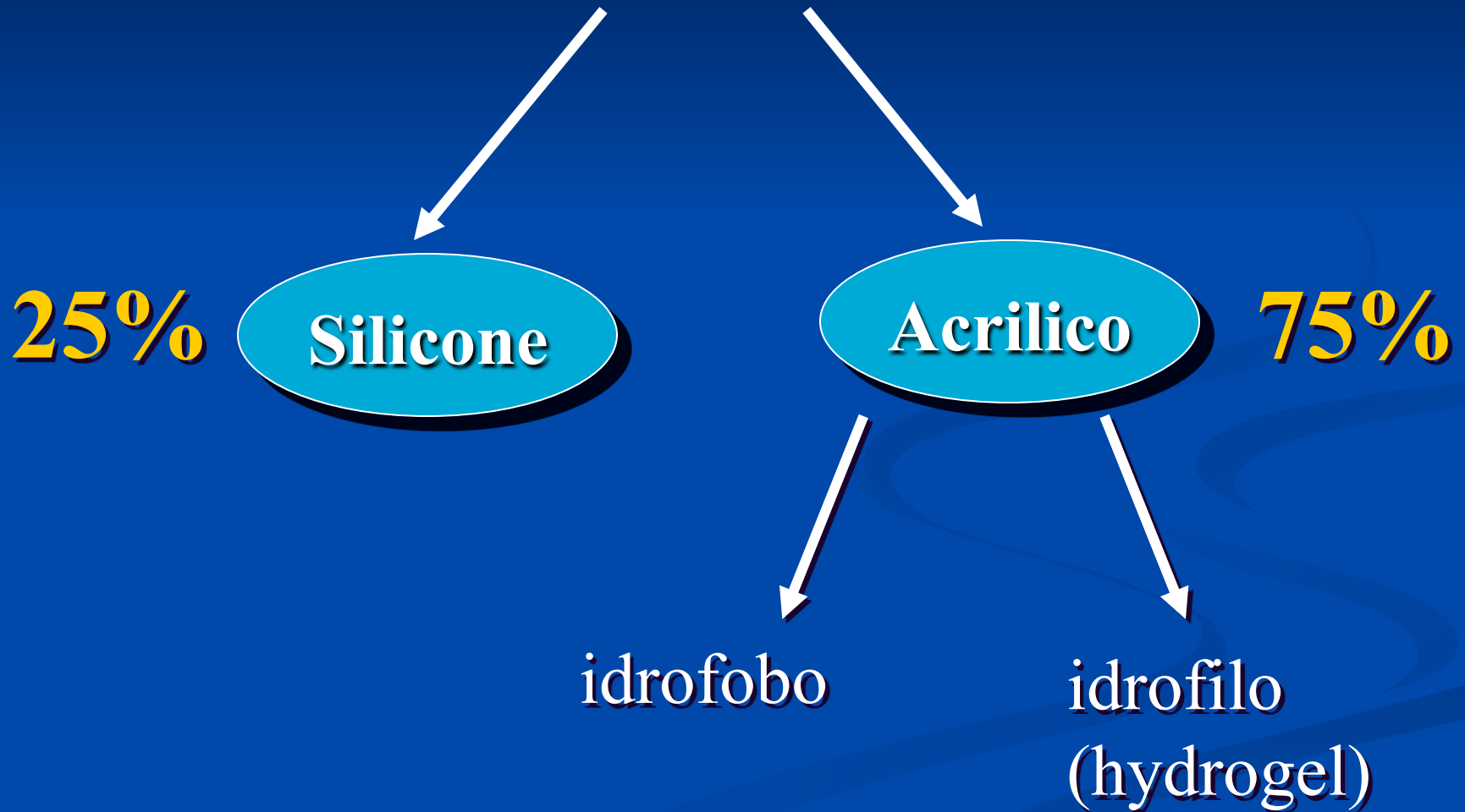
**silicone
elastomers**

- dimethylsiloxane (DMS)
- dimethyldiphenylsiloxane (DMDPS)

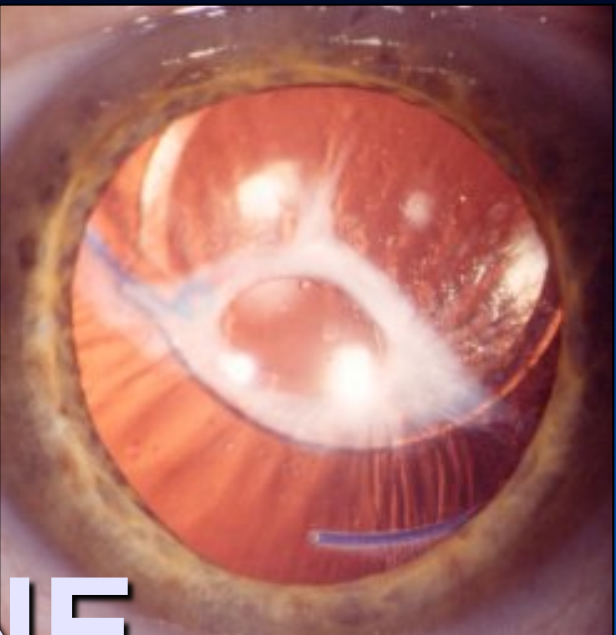
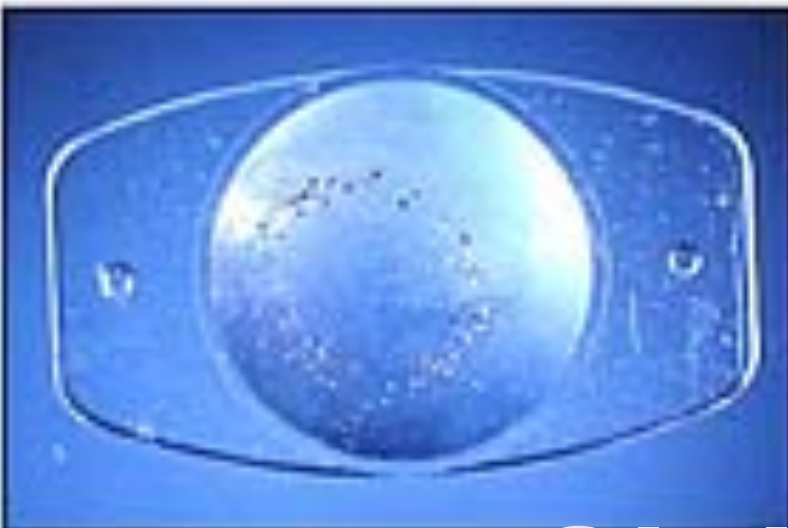
**Adatomed 90D, Chiron C10UB,
Staar AA-4203,
Allergan SI-18NGB/SI-26NB**
- hydrophobic
- R.I.: 1.41 W.C.: <1%

**Iolab Soflex, Domilens Silens,
Pharmacia Cee ON 920 /
Allergan SI-30NB/SI-40NB**
- hydrophobic
- R.I.: 1.43 / 1.46 W.C.: <1%

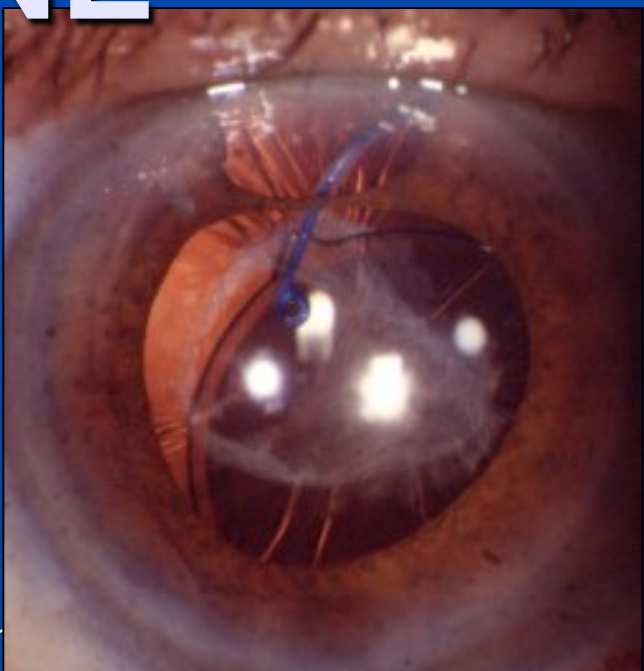
IOL PIEGHEVOLI



Da APPLE



SILICONE



ELLE IOL
Esente

Dr

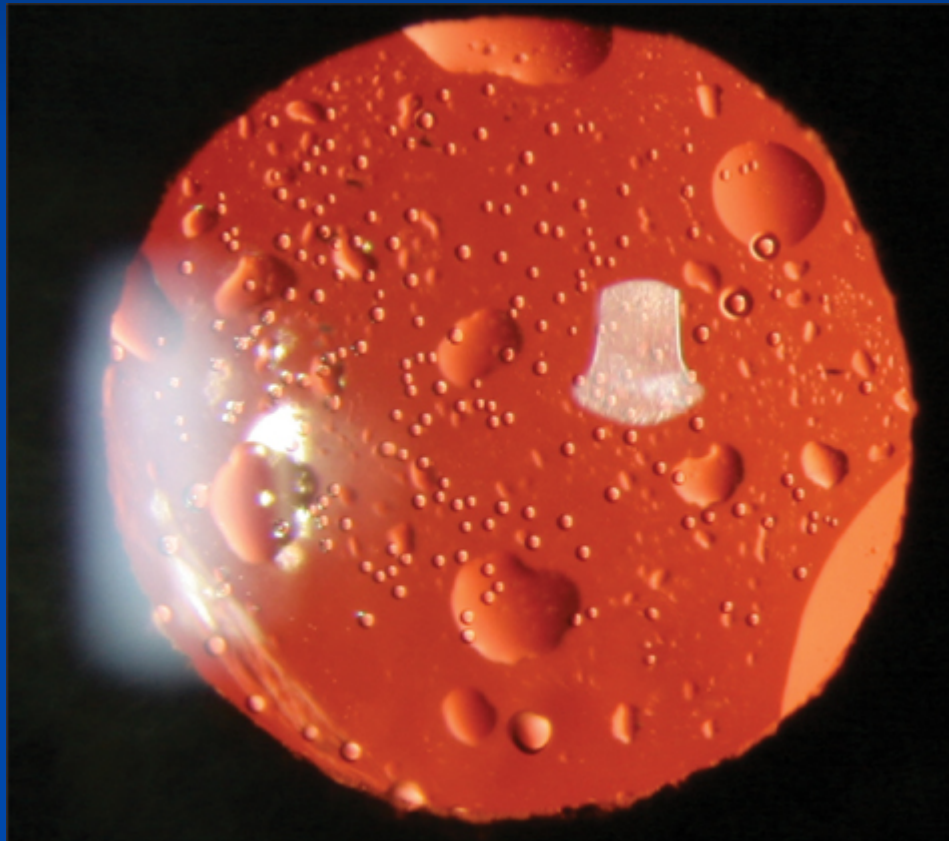
SILICONE 1°, 2°, 3° generazione

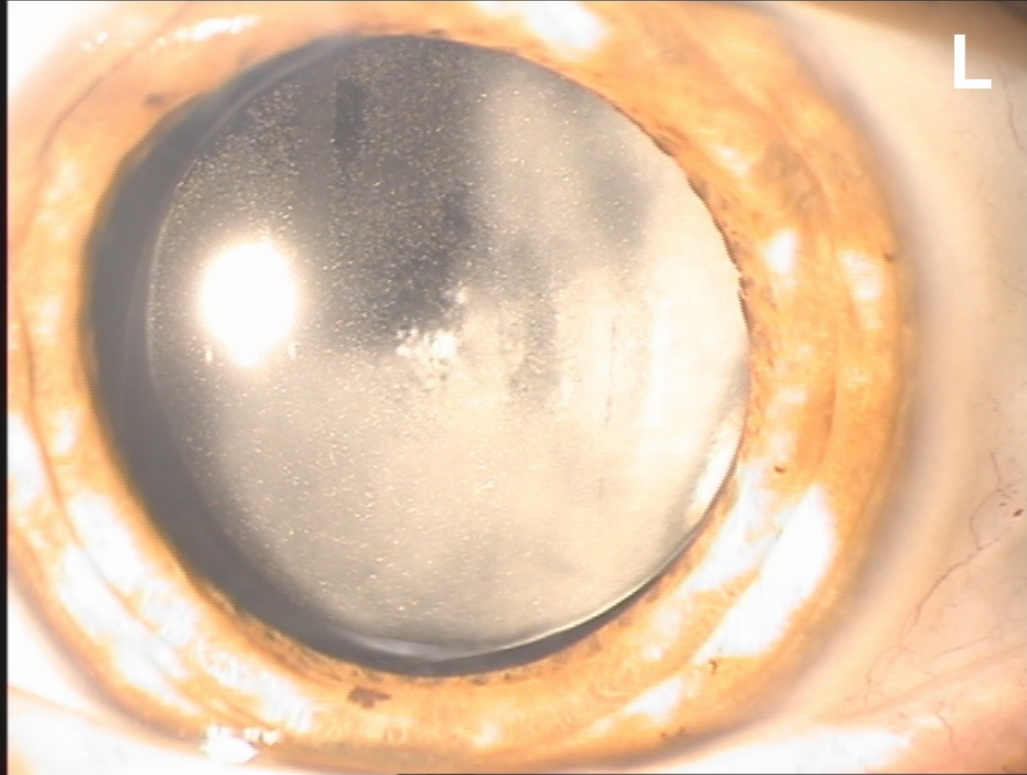
■ VANTAGGI

- **CHIMICI** materiale facile lavorazione a costi più bassi del PMMA
- **MICROBIOLOGICI** sterilizzazione in autoclave
- **BIOLOGICI** ottima biocompatibilità
- **CLINICI** maneggevole, minimo danno endoteliale

■ SVANTAGGI

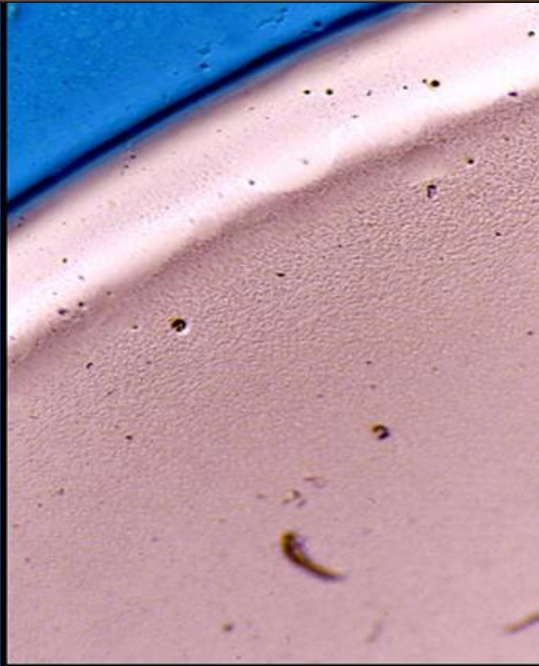
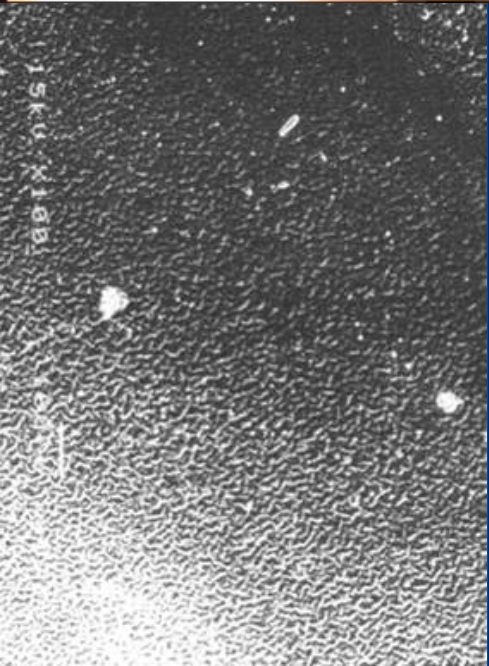
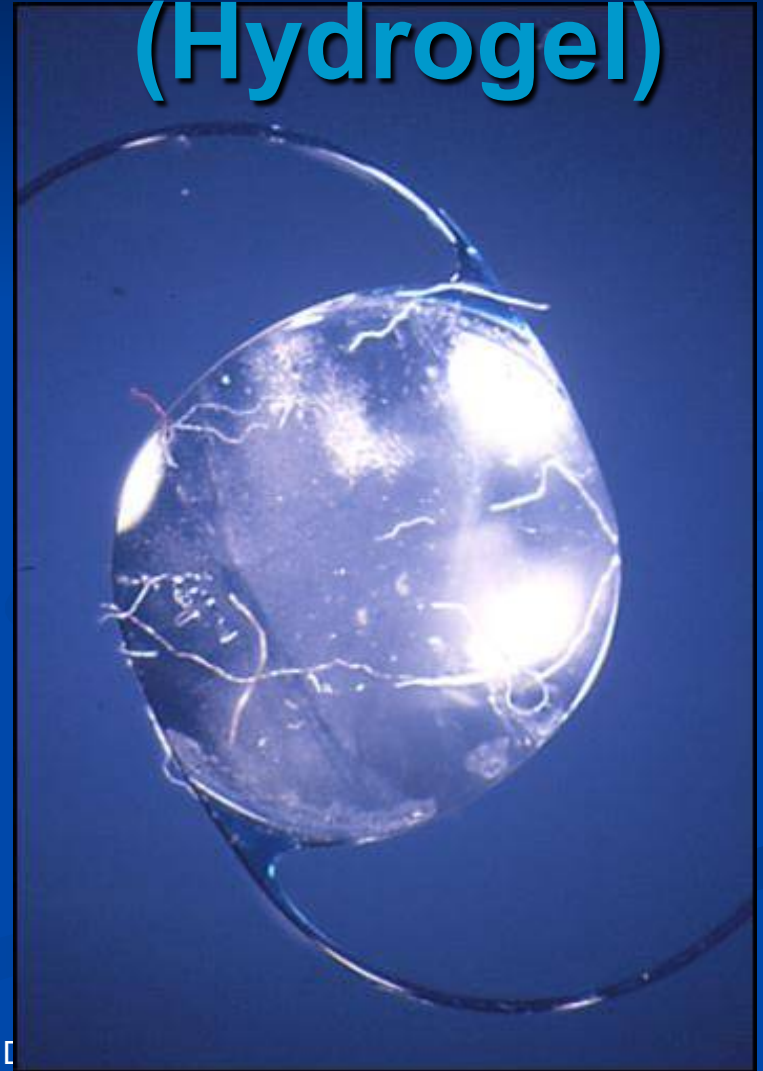
- **Decentramento**
- Basso indice di rifrazione (spessore !!)
- **Sensibilità YAG laser**
- Interazione con olio di silicone





L

ACRILATI IDROFILI (Hydrogel)



Complications and clinical outcomes of intraocular lens exchange in patients with calcified hydrogel lenses

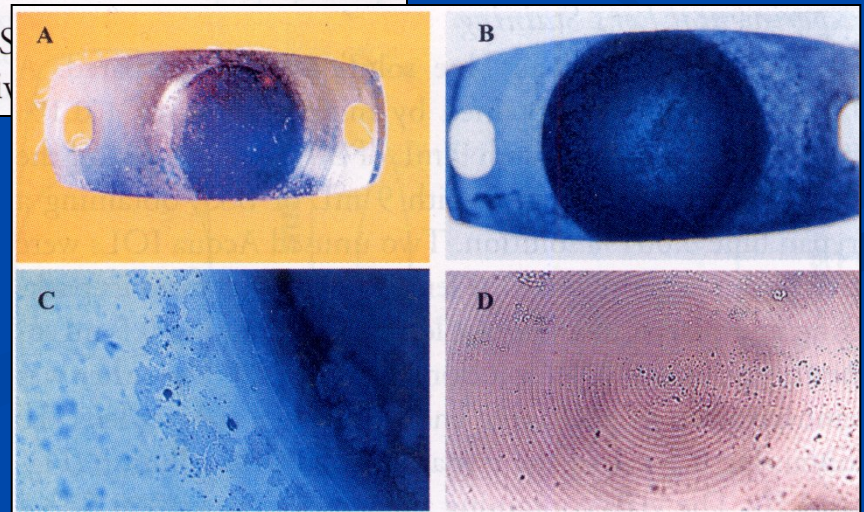
Alexis K.F. Yu, MBBS, FHKAM(Ophth), Anita S.Y. Ng, MBBS

Progressive opacification of hydrophilic acrylic intraocular lenses in diabetic patients

Do-Hyung Lee, MD, PhD, Yeon Seo, MD, Choun-Ki Joo, MD, PhD

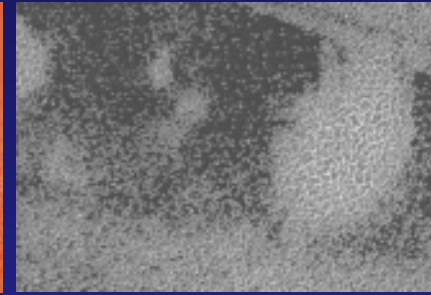
Permanent blue discoloration of a hydrogel intraocular lens by intraoperative trypan blue

Liliana Werner, MD, PhD, David J. Apple, MD, Armando S. Izak, MD, Suresh K. Pandey, MD, Rupal H. Trivedi, MD

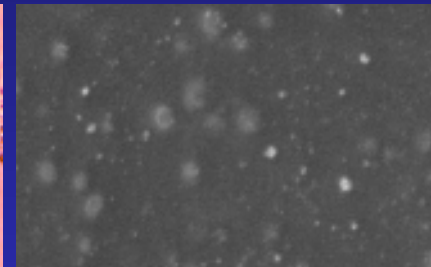
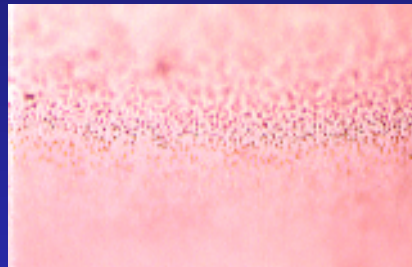


Dystrophic Calcification of Hydrophilic Acrylic Designs

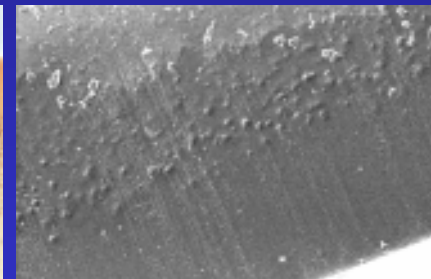
Source: Liliana Werner, MD, PhD, Moran Eye Center



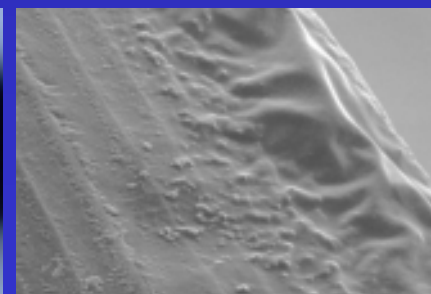
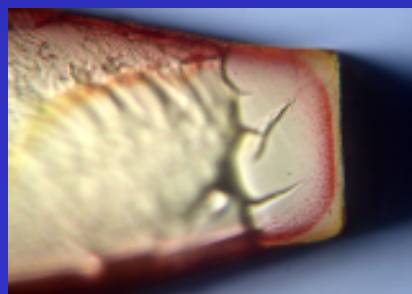
Hydroview



MemoryLens



SC60B-OUV



Aqua-Sense

Designs

Alizarin red stain

SEM

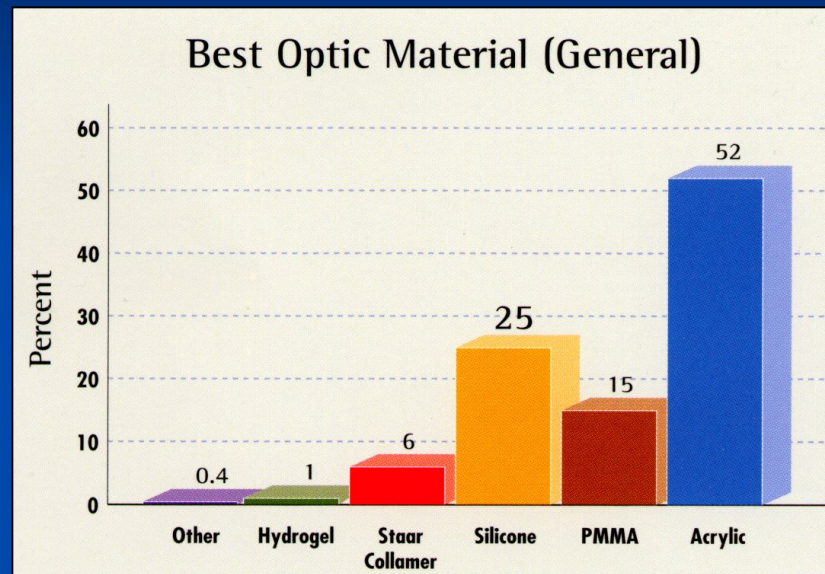
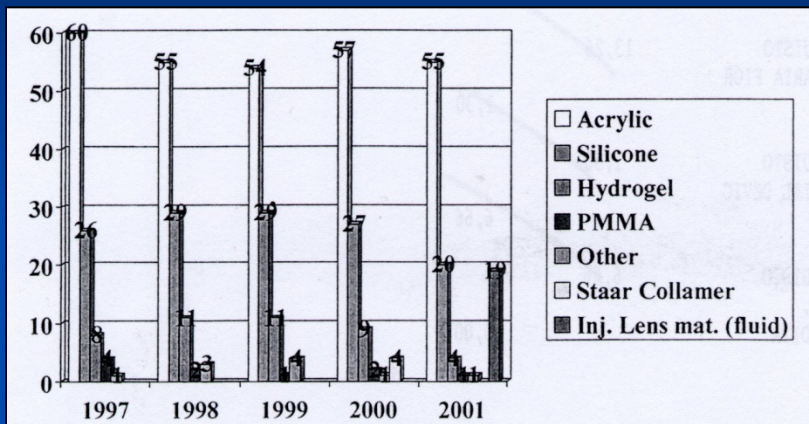
ACRILICO IDROFOBO

- Disponibile monopezzo o 3 pezzi
- Alto indice di rifrazione (poco spessore)
- Pieghevoli o iniettabili
- UV Blocker
- Struttura chimica fluorinata
- Angolo di contatto con acqua variabile

Materiali Acrilici Idrofobici

Materiali più usati per le lenti pieghevoli

(Leaming DV, J Cataract Refract Surg 2002;28:1681-1688)



INERZIA BIOLOGICA

**UTILIZZABILE in TUTTE le
PATOLOGIE**

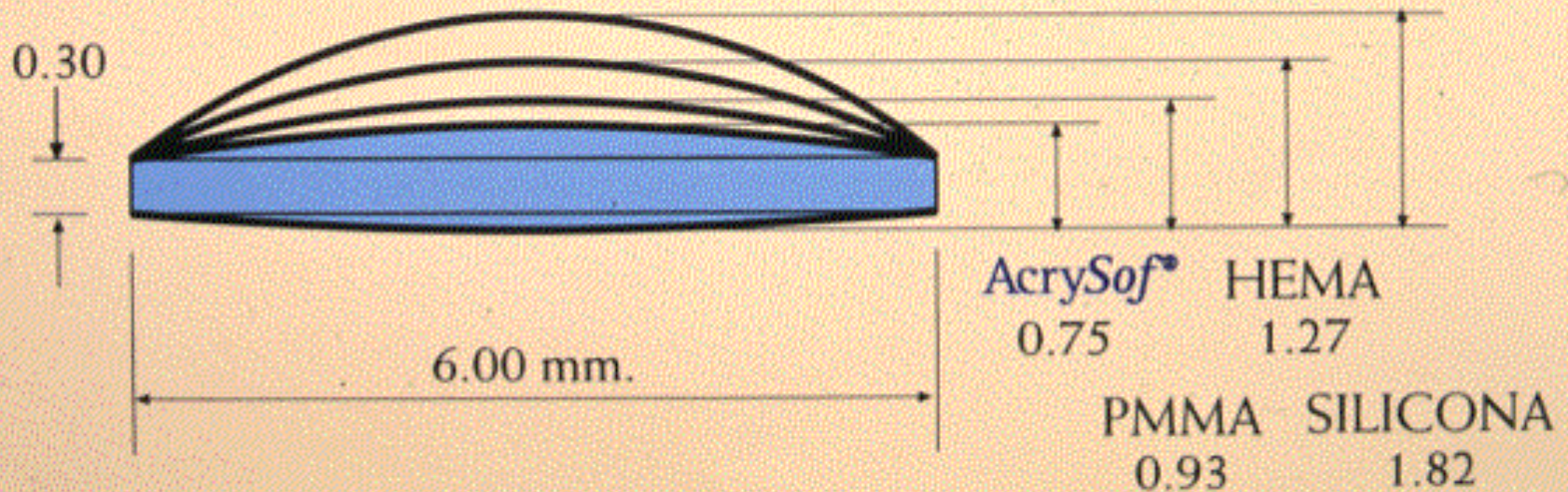
	'98	'99	'00
Acrylic	55%	54%	57%
Silicone	29%	29%	27%
Hydrogel	11%	11%	9%
PMMA	2%	1%	2%
Other	3%	4%	1%
Staar Collamer	0%	0%	4%

Acrilico vs Silicone

- Maggiore indice rifrazione = minore spessore IOL 21 dpt Acrysof = 0.75mm
- Ottimo controllo della piegatura e dello svolgimento anche “bagnata”
- Ottima performance ottica
- PCO rate /=/ bordo
- 21 dpt = 1.82 mm
- Difficoltà nel prendere, piegare, scarso controllo, ancora peggio se “bagnata”
- Buona performance ottica
- PCO rate /=/ bordo

IOL Thickness Based on Refractive Index

*IOL Thickness Comparison for Several Materials
(Biconvex @ 21.0 Diopters)*



Biocompatibilità / Clinica

■ PCO

- YAG laser %

■ PATOLOGIA DEL “SACCO”

- Contrazione
- Fimosi
- Decentramento IOL

Cataratta secondaria



PLURIFATTORIALITA' proliferazione dell'epitelio capsulare = PCO

Surgeon Factors

Position

CCC

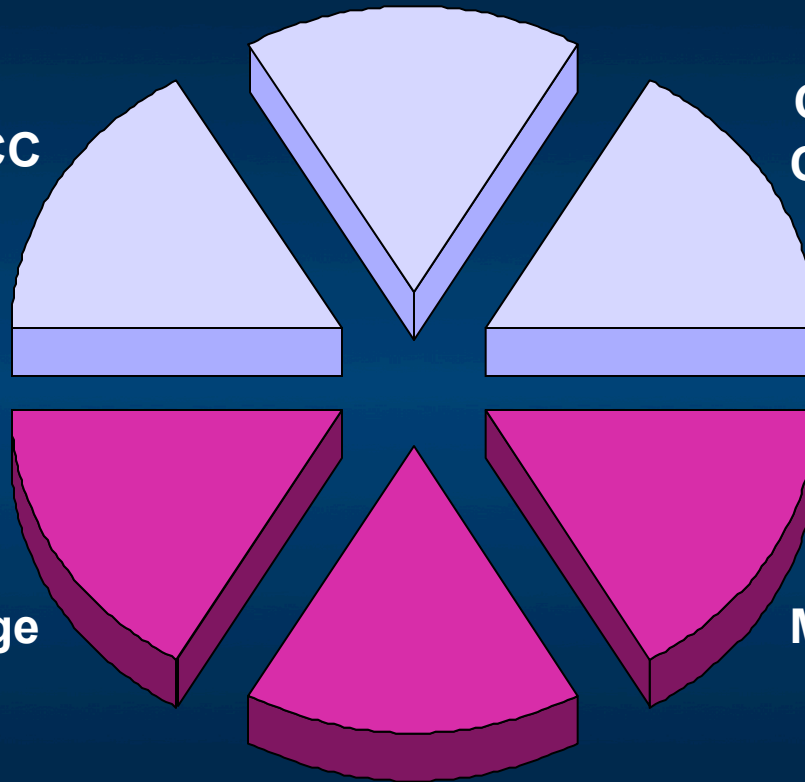
Capsular Clean-Up

Square Edge

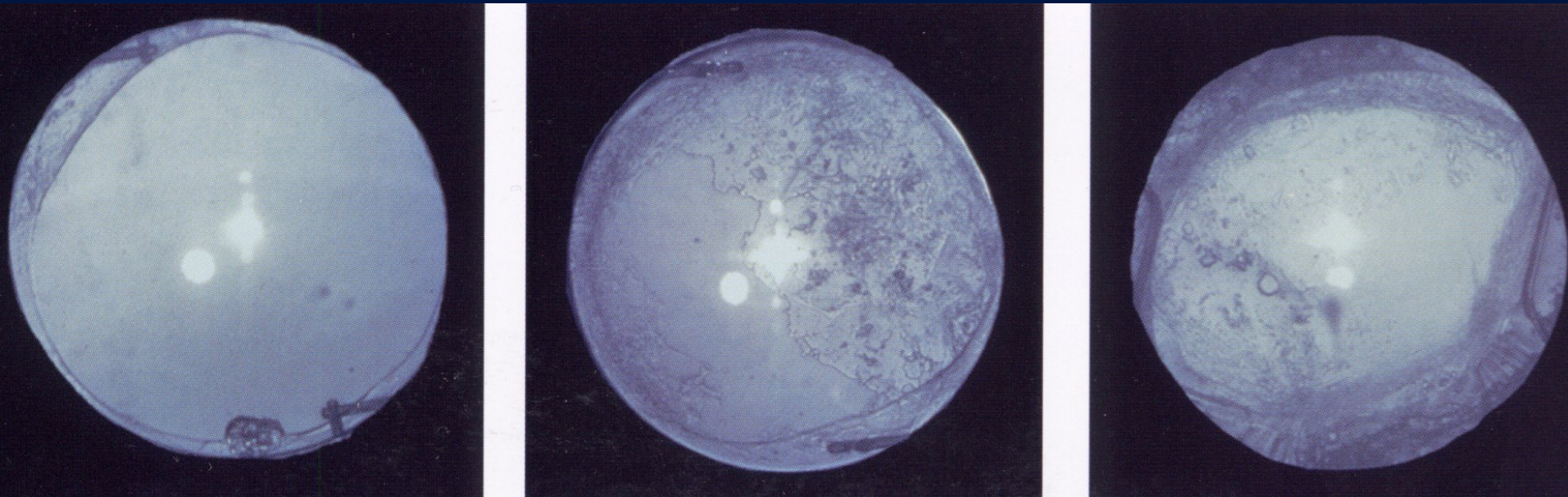
Material

Adhesion

Lens Factors



Stato della capsula posteriore a 3 anni



ACRILICO

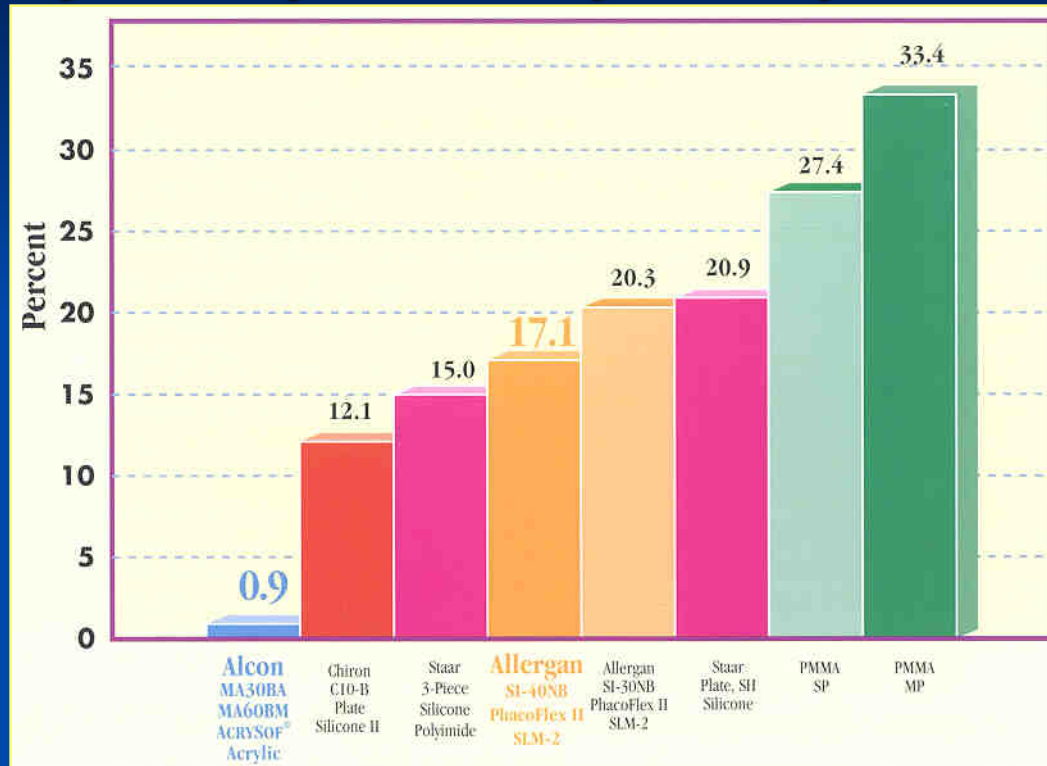
PMMA

SILICONE

Relationship between intraocular lens biomaterials and posterior capsule opacification

Paul G. Ursell, FRCOphth, David J. Spalton, FRCP, FRCS, FRCOphth, Milind V. Pande, FRCS, FRCOphth, Emma J. Hollick, FRCOphth, Sarah Barman, PhD, James Boyce, PhD, Kate Tilling, MSc

AcrySof® Nd:YAG Capsulotomy Data January 1988 to January 2000



Conclusions: “...we noted that the Alcon AcrySof® IOL has the lowest Nd:YAG laser...rate of all lenses studied...”

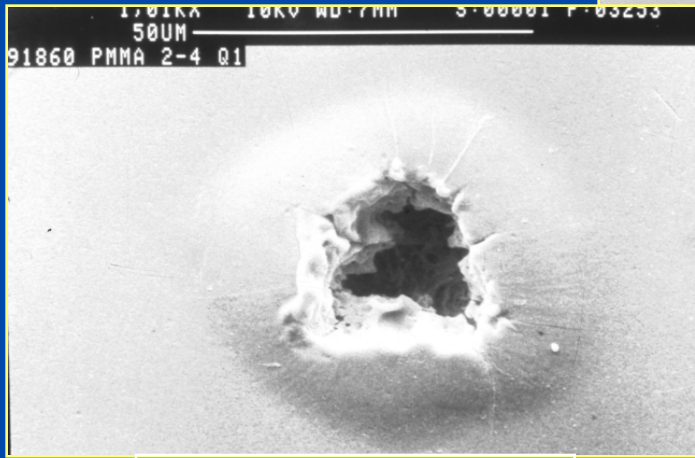
David Apple, M.D.
May 4, 2000

Danni da Nd YAG laser

- Acrylic compares favourably to Silicone and PMMA after Nd:YAG Laser treatment



Silicone
1.2 MJ



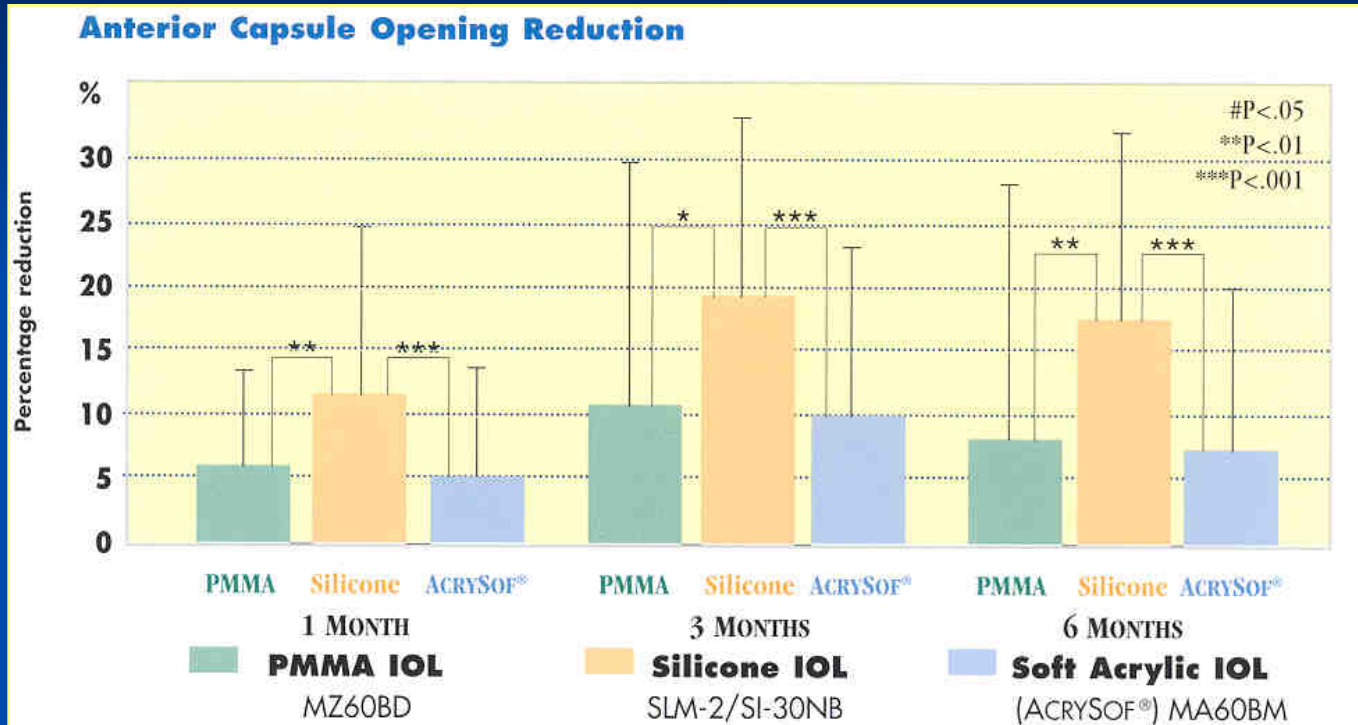
PMMA 1.2 Mj

AcrySof
1.6 Mj



Materiali acrilico

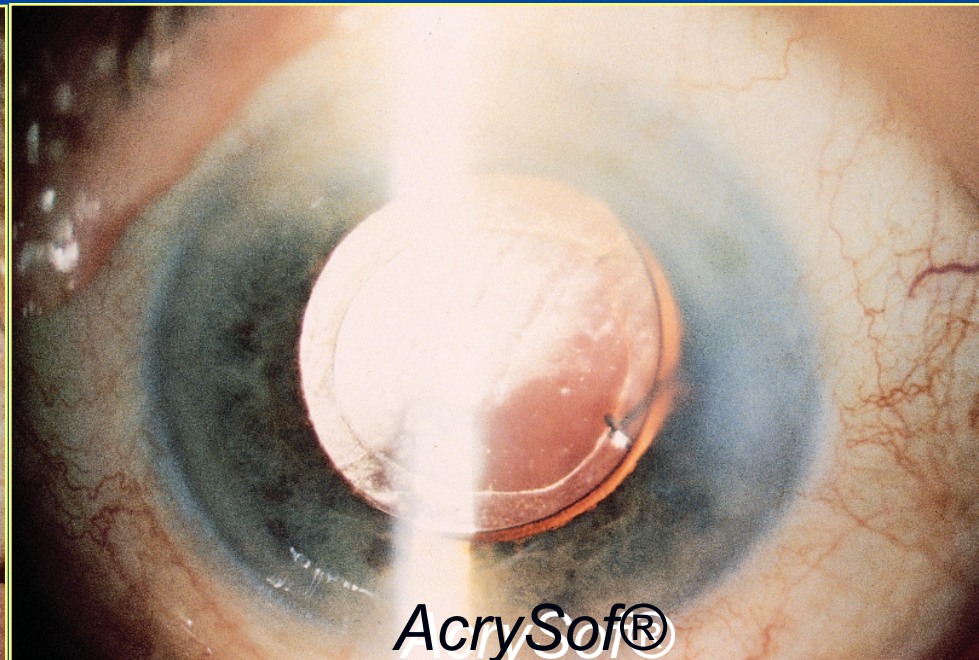
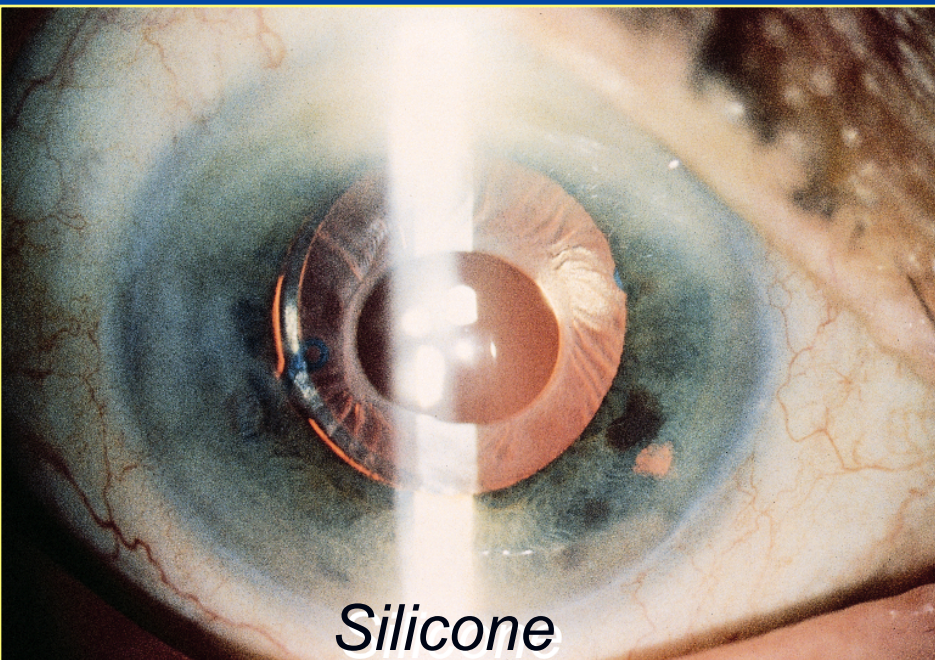
Contrazione Capsulare /Fimosi



Conclusions: “...the anterior capsule fibrosis over the soft acrylic optic was extremely slight.”

Biocompatibilità

- Contrazione della capsula anteriore / Fimosi

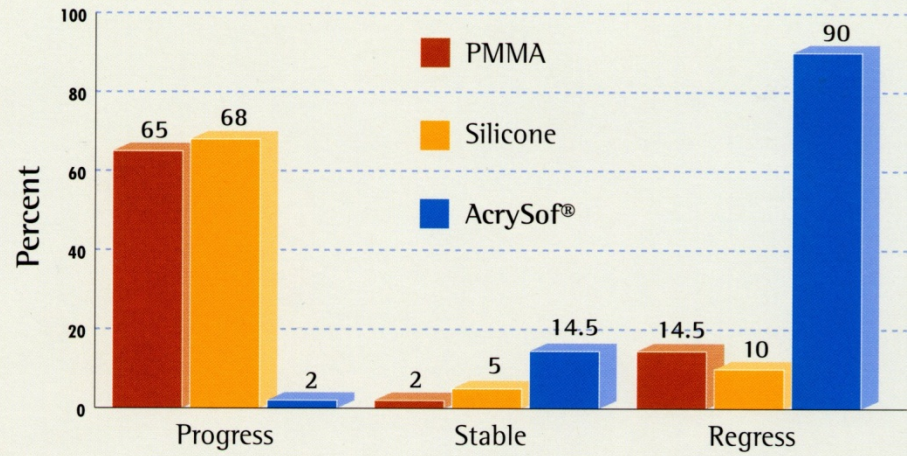


Stesso paziente a 4 mesi con CCC dello stesso diametro intra-op

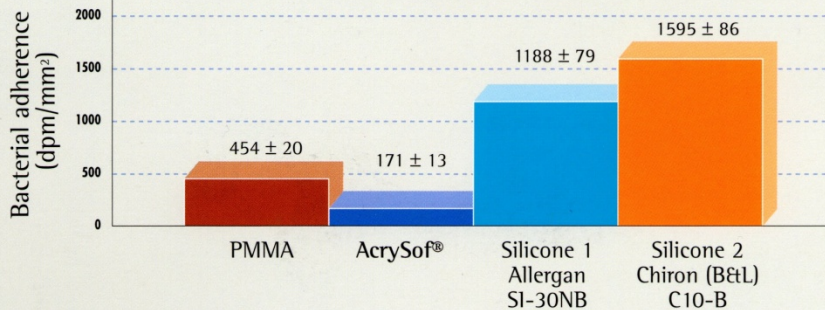
Biocompatibility of poly(methyl methacrylate), silicone, and AcrySof intraocular lenses: Randomized comparison of the cellular reaction on the anterior lens surface

Emma J. Hollick, FRCOphth, David J. Spalton, FRCP, FRCS, FRCOphth, Paul G. Ursell, FRCOphth, Milind V. Pande, FRCS, FRCOphth

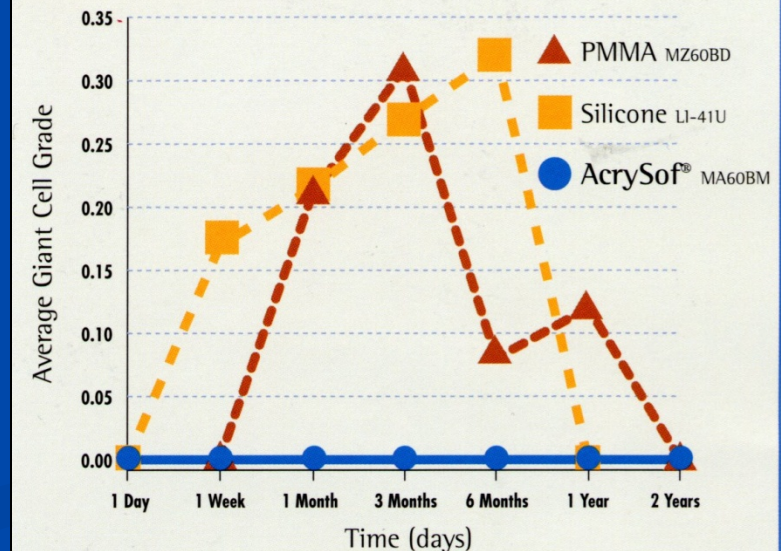
Influence of IOL Material on LEC Behavior



Bacterial Adherence



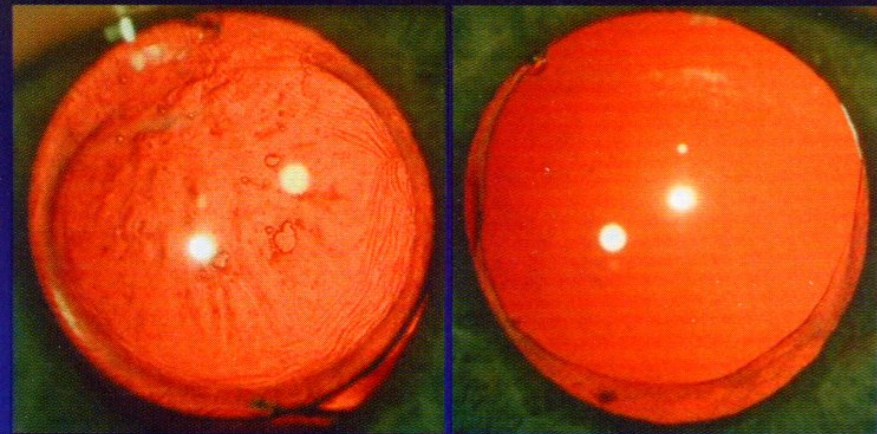
Giant Cell Adherence



ACRILICO IDROFOBO
+ sicurezza
- reattività

Non è solo il materiale che cambia le prestazioni....

PMMA

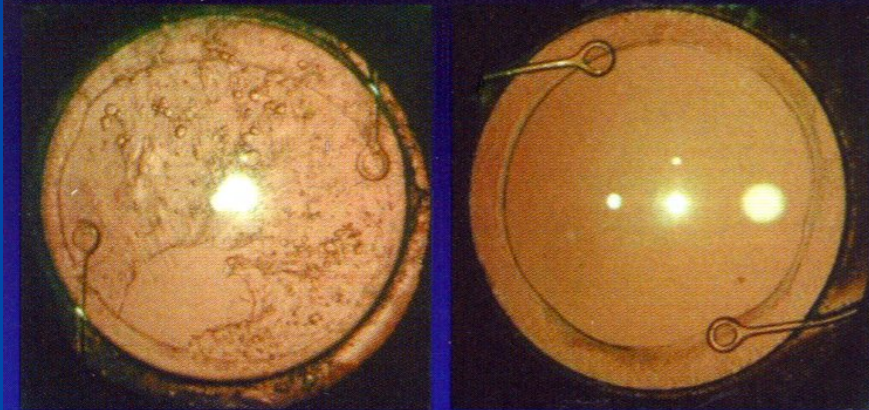


round edge

2 years

sharp edge

Silicone



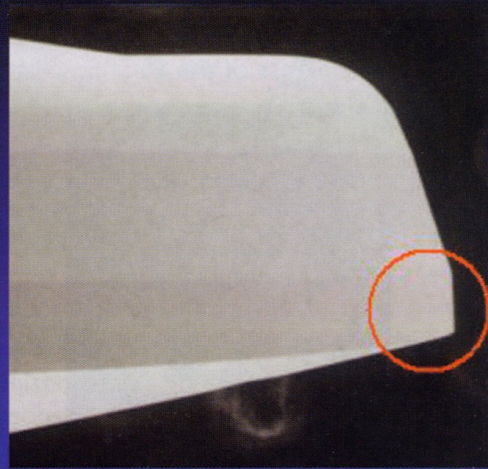
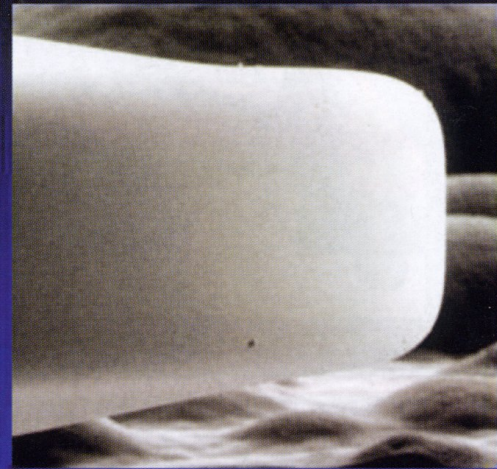
round edge

2 years

sharp edge

Courtesy of Rupert Menapace

IOL design



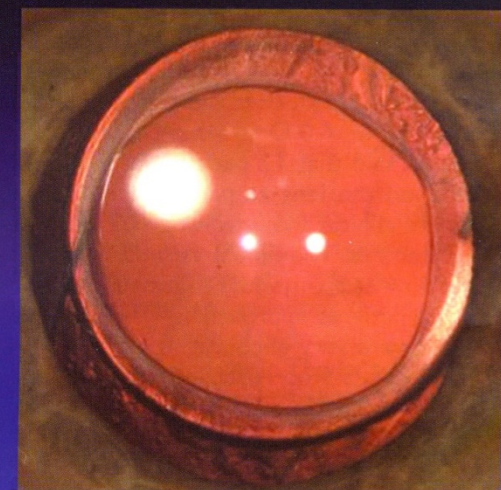
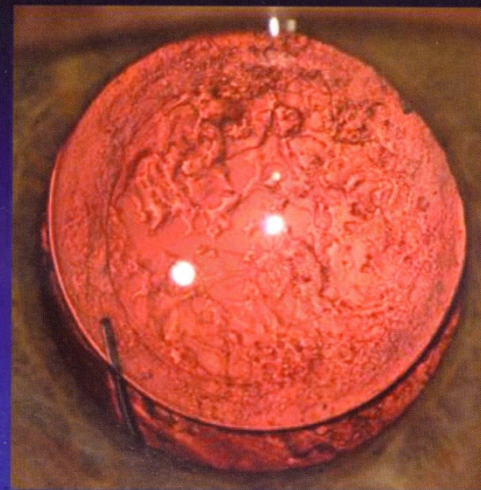
La
BIOCOMPATIBILITA'
non è solo legata al
MATERIALE, ma
anche e soprattutto ai
particolari

AR40

AR40e

Il cambio di un
particolare migliora le
qualità cliniche e
diminuisce le
complicazioni

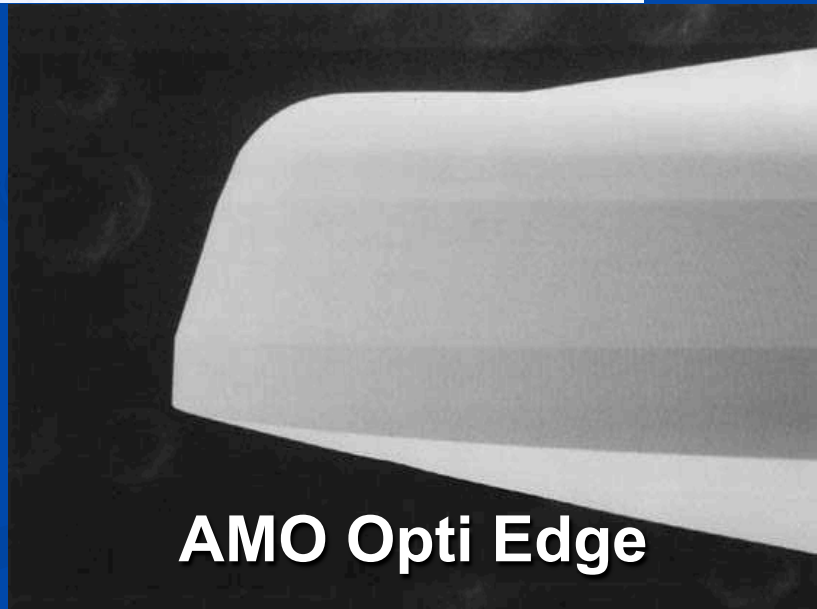
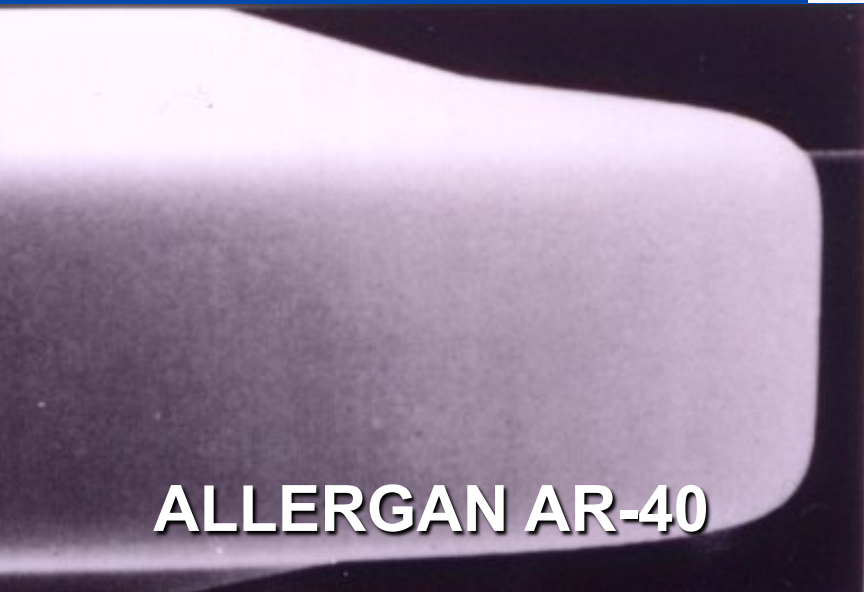
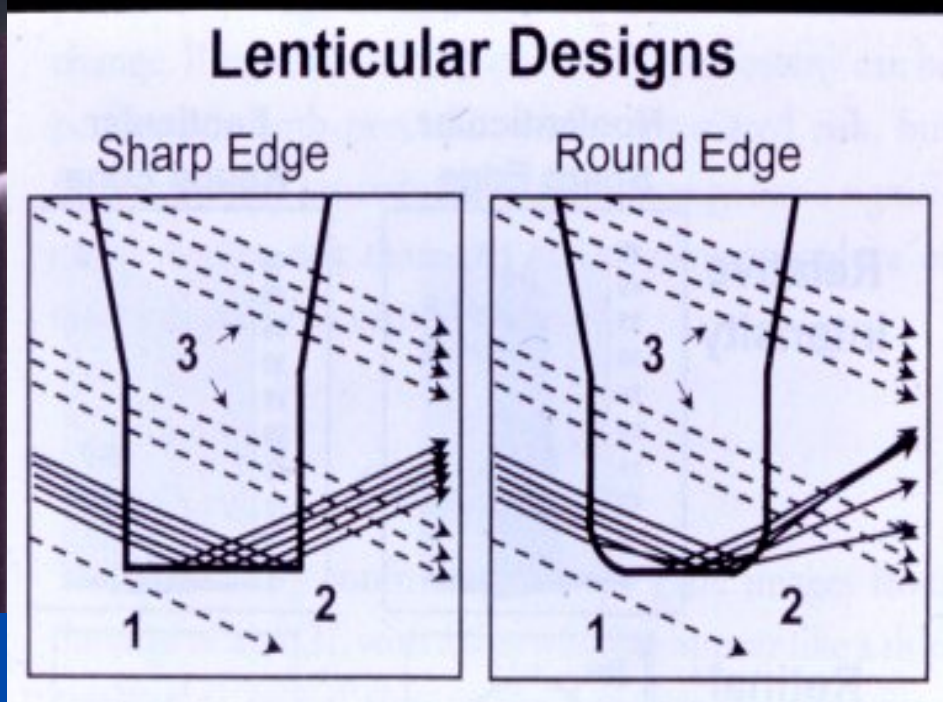
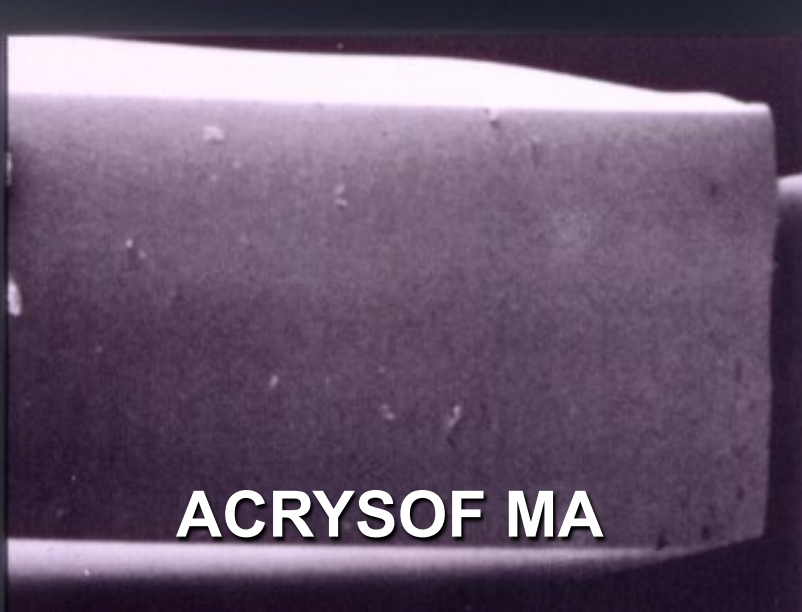
Examples (3 years)



OD AR40
T. J.

OS AR40e



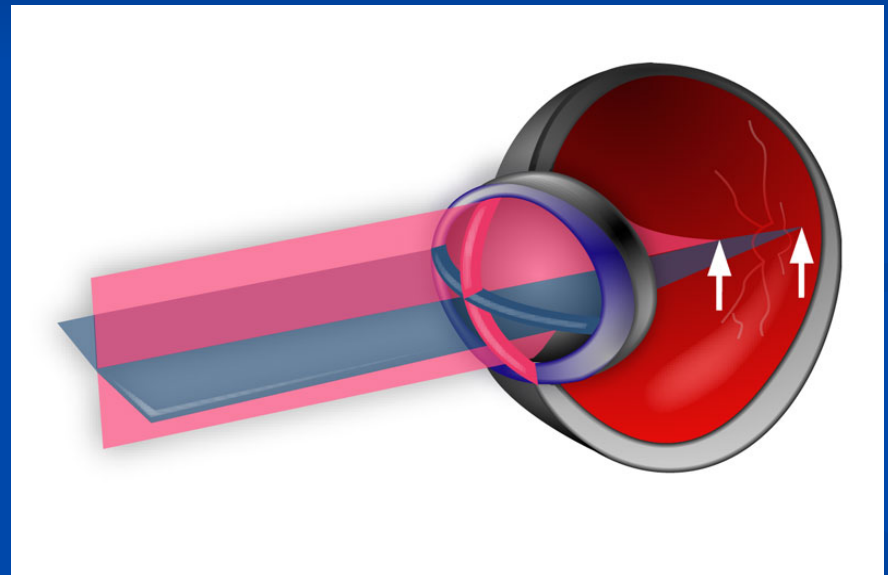
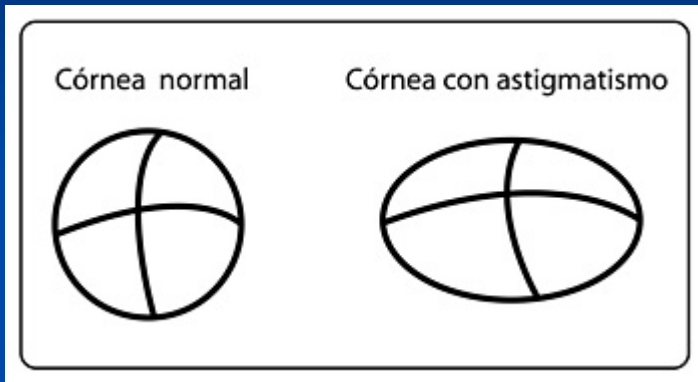


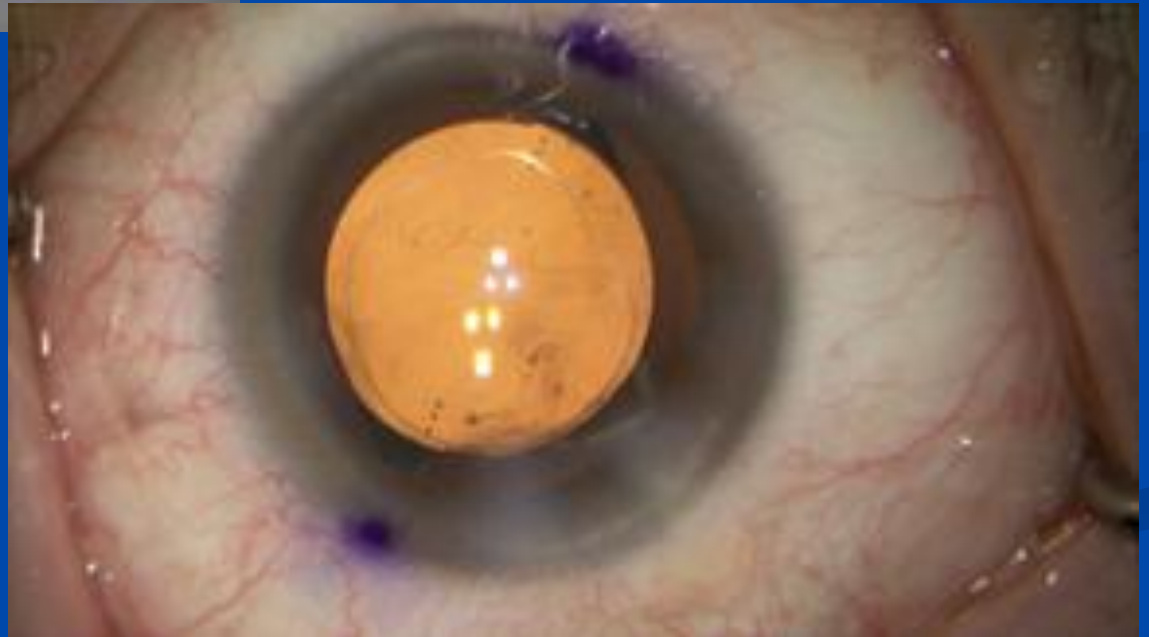
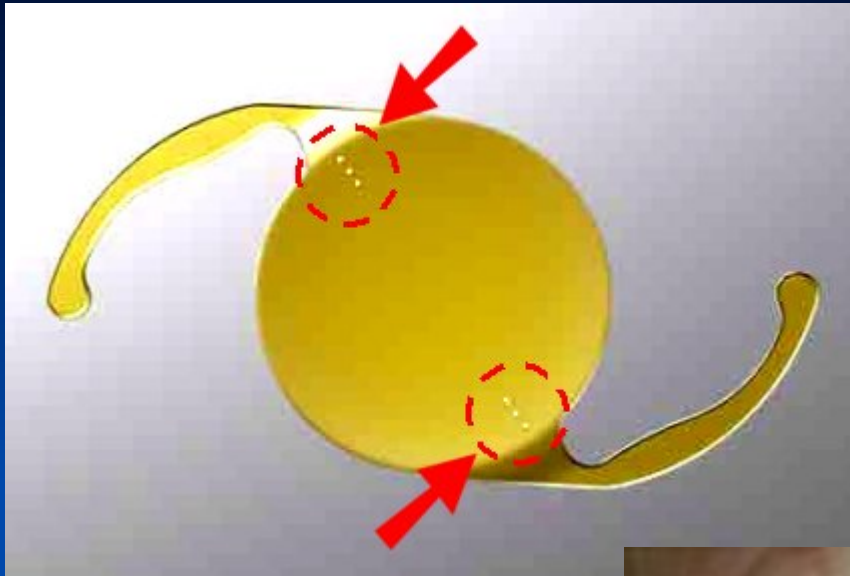
Scelta di IOL = CUSTOM

- IOL MONOFOCALI
- IOL TORICHE
- IOL MULTIFOCALI

IOL TORICHE

■ Correzione astigmatismo





IOL MULTIFOCALI

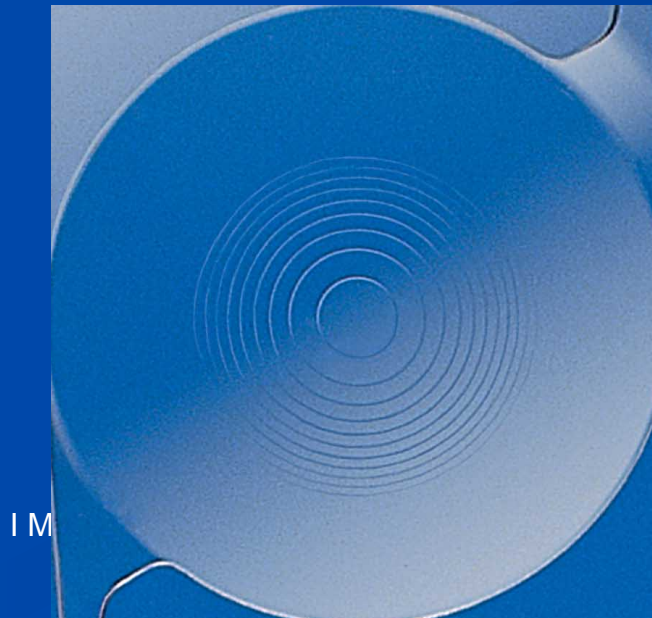
- **Array multifocal AMO**

5 zone ottiche

- **Acrysof Multifocal Restor**

Diffrattiva

Acrilico idrofobo





Smart Injectable IOL

Lente “termo regolata” Polimero Iniettabile

A T° organica = gel stabile

A T° sala op = si trasforma in un sottile cono iniettabile
nel sacco capsulare dove si trasforma in “gel”
accomodativo



Smart Injectable IOL

Polimero iniettabile, acrilico idrofobo, gelatinoso, termodinamico (stabile a T°organica) Inserita attraverso 2mm, riempie il sacco capsulare e si lega alla fibronectina attaccandosi alla capsula posteriore.

