



XVI CONGRESSO
SOCIETÀ
OFTALMOLOGICA
CALABRESE
SOC

SEMEIOTICA CORNEALE HI-TECH

Dr Giovanna Gabbriellini

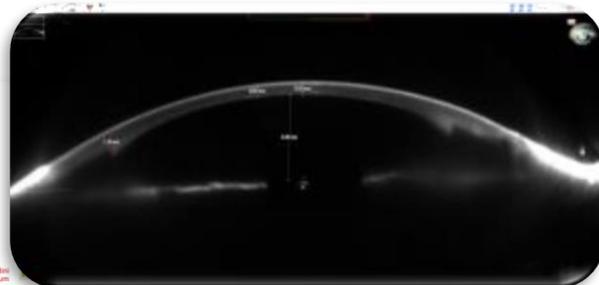
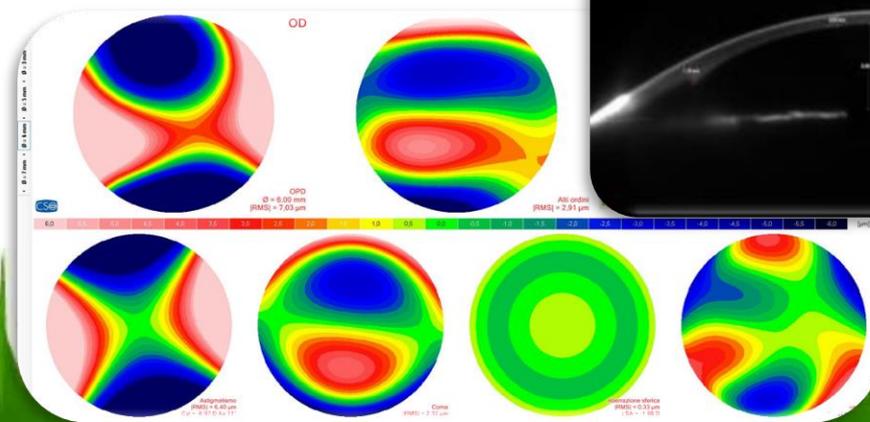
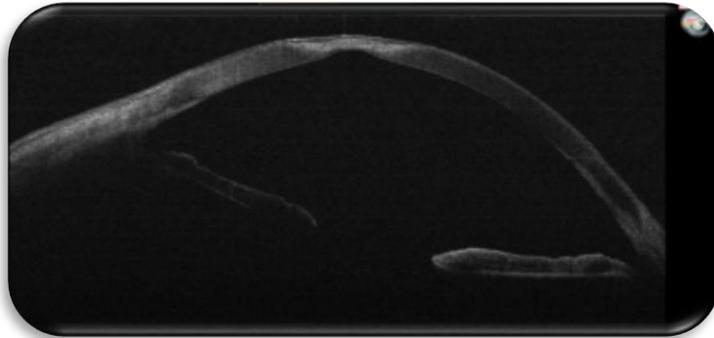
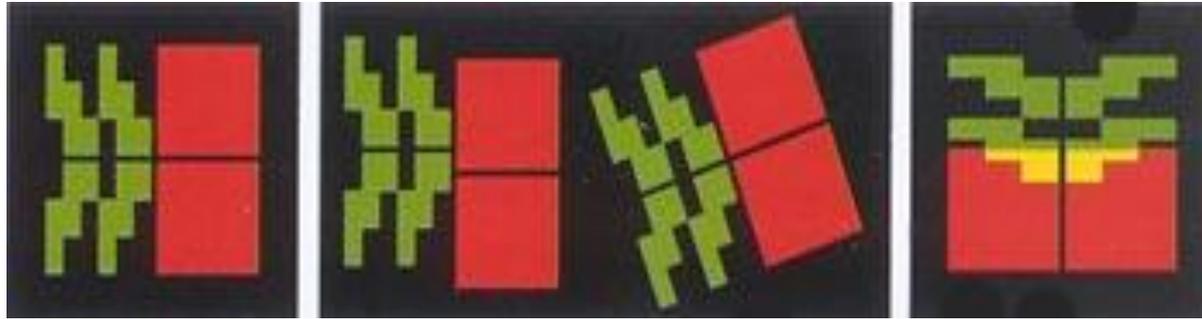
Università degli Studi di Pisa

AZIENDA OSPEDALIERO-UNIVERSITARIA PISANA

U.O. Oculistica Universitaria

Direttore Prof. Marco Nardi





Tomografi con Scheimpflug camera

PENTACAM

SIRIUS

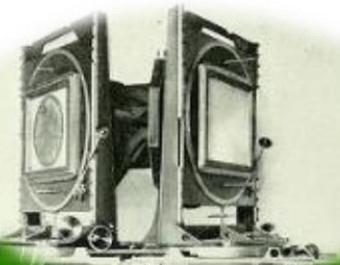




Tomografi con Scheimpflug camera

"Quando il piano su cui giace il soggetto, il piano nodale posteriore dell'obiettivo e il piano focale si incontrano in un unico punto, si ottiene la piena messa a fuoco del soggetto indipendentemente dal diaframma utilizzato".

- Imaging cornea e camera anteriore
- Misura angolo camerulare
- Mappe ad elevazione
- Screening per chirurgia refrattiva
- Ectasia
- Analisi densitometrica della cataratta
- Pachimetria corneale automatica, manuale
- Topografia corneale anteriore e posteriore
- Analisi film lacrimale
- Aberrazioni
- Analisi qualità visiva
- IOL Fachiche
- Modulo pupillometria



Journal of Ophthalmology
Volume 2015 (2015), Article ID 315281,
Comparison of Two Different Scheimpflug Devices in the Detection of
Keratoconus, Regular Astigmatism, and Healthy Corneas
[David Finis](#), [Bernhard Ralla](#), [Maria Karbe](#), [Maria Borrelli](#), [Stefan
Schrader](#), and [Gerd Geerling](#)



Pachymetry values were also compared with ultrasound pachymetry as a reference measurement. To detect possible differences between the two devices, 82 eyes with clinically established keratoconus, 30 eyes with regular astigmatism (>1.5 D), and 60 eyes without corneal pathologies were included in this prospective study. *Results.* Pachymetry and keratometry showed good intra- and interobserver variability for both devices. Pachymetry values obtained with the Sirius system (μm) were significantly higher compared to the Pentacam system (μm ,) and to ultrasound pachymetry (μm ,). Significant interdevice differences were found regarding the majority of the detected keratometry parameters.

Conclusions. Both devices show almost perfect reproducibility in healthy subjects.

However, pachymetry and keratometry values of the two devices should not be used interchangeably.

[J Refract Surg.](#) 2012 Jul;28(7):493-7. doi: 10.3928/1081597X-20120619-01.

Repeatability of the Sirius imaging system and agreement with the Pentacam HR.

[Nasser CK](#)¹, [Singer R](#), [Barkana Y](#), [Zadok D](#), [Avni I](#), [Goldich Y](#).

[Author information](#)

Abstract

PURPOSE:

To assess measurement repeatability of corneal curvature, minimal corneal thickness, and anterior chamber depth obtained with the Sirius imaging system (Costruzioni Strumenti Oftalmici) and to assess its agreement with the Pentacam HR imaging system (Oculus Optikgeräte GmbH).

CONCLUSIONS:

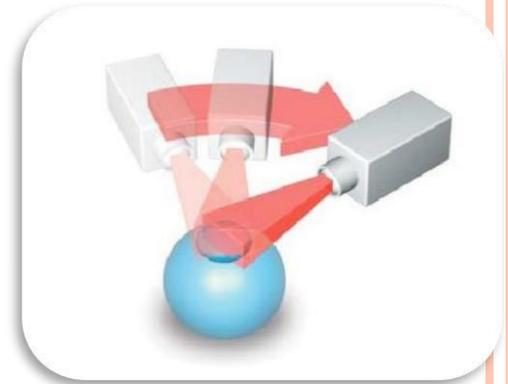
The Sirius showed good to excellent repeatability for all measured parameters. Agreement analysis suggests that Sirius and Pentacam should not be used interchangeably.

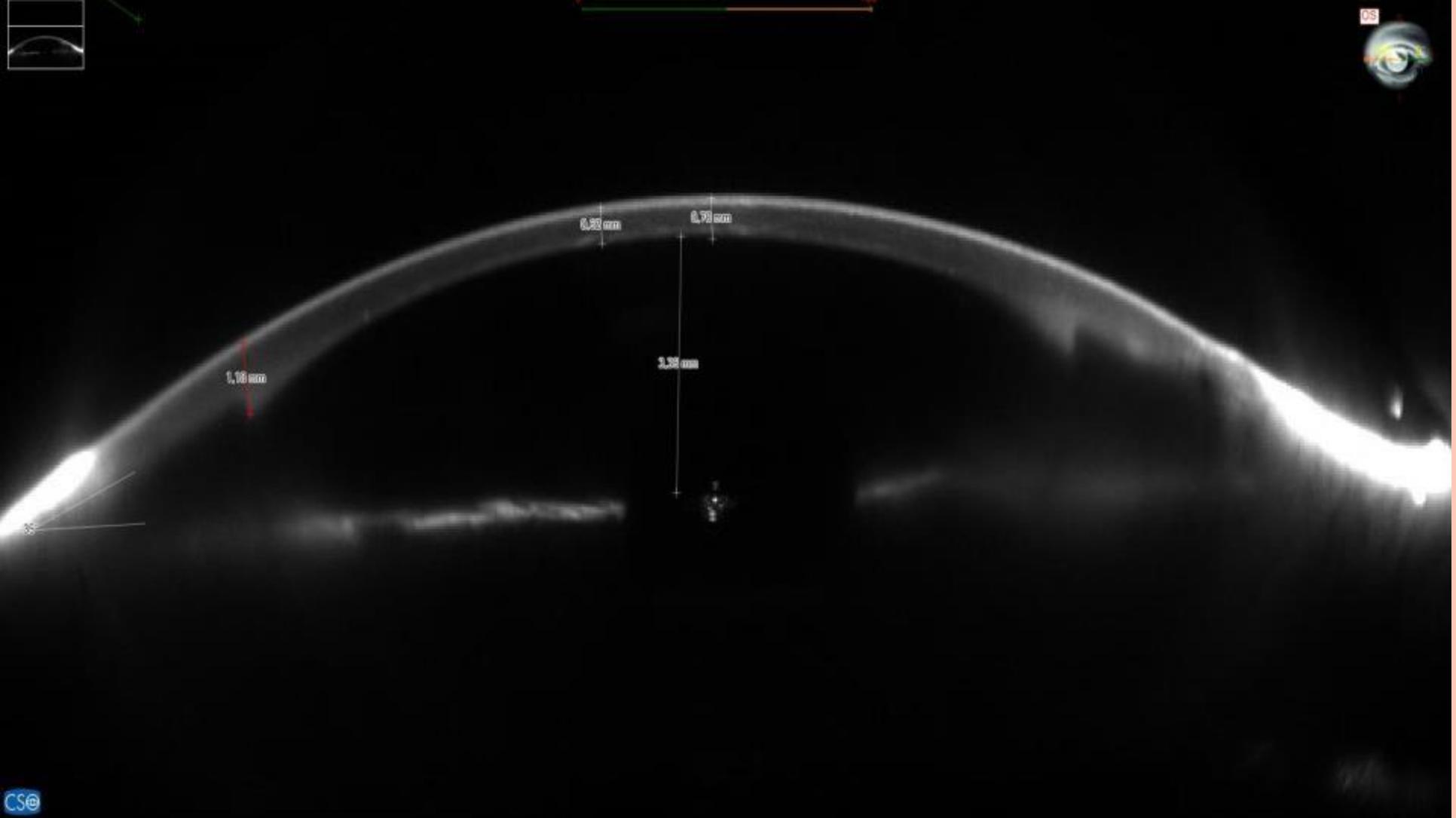
TOMOGRAFI

SCHEIMPFLUG CAMERA

LA TERZA DIMENSIONE

Mettendo in rotazione il sistema (illuminatore e telecamera solidali) si ottengono sezioni della cornea che permettono una misurazione tridimensionale camera anteriore e delle strutture in essa presenti.

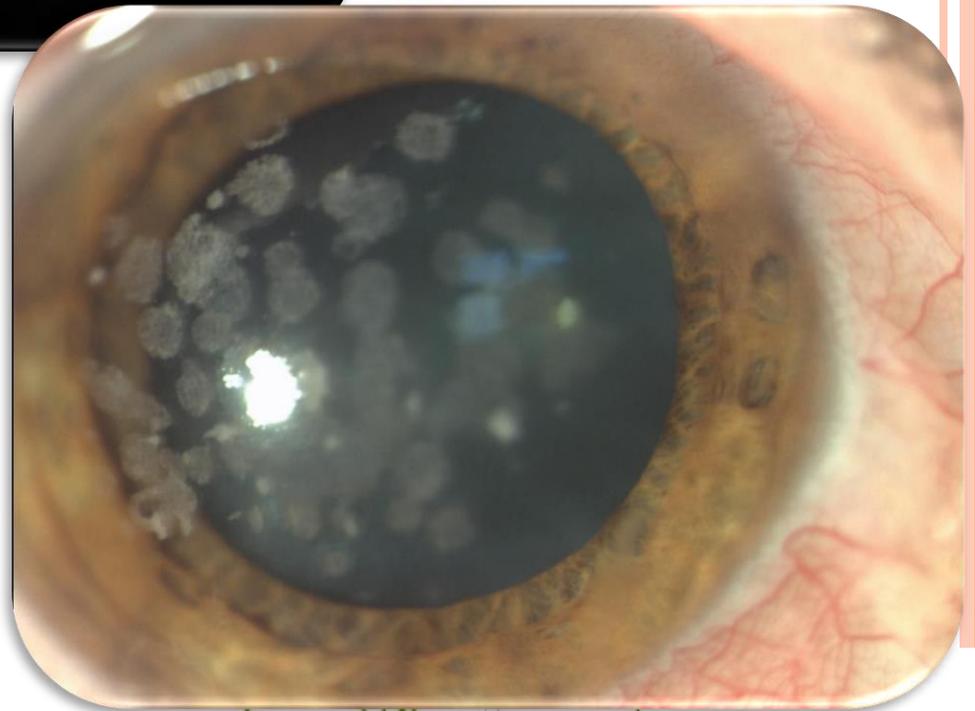


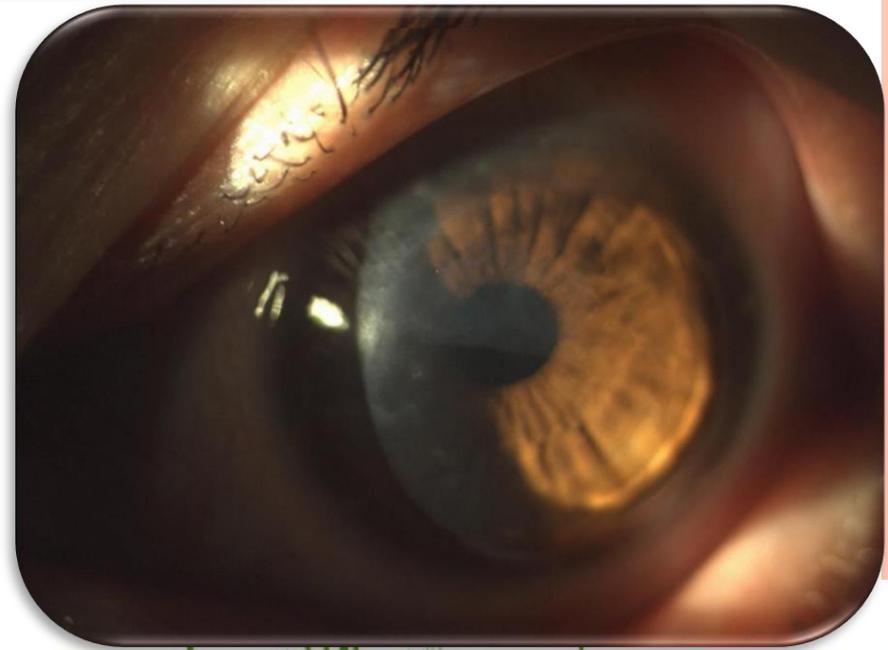
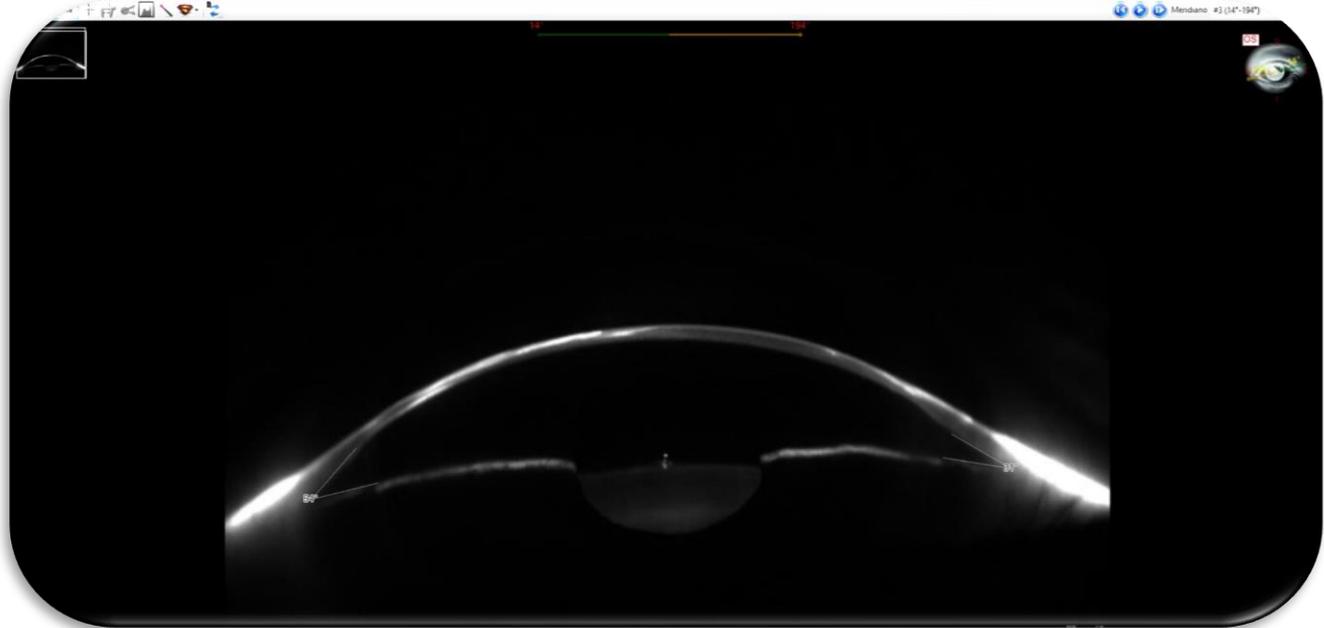


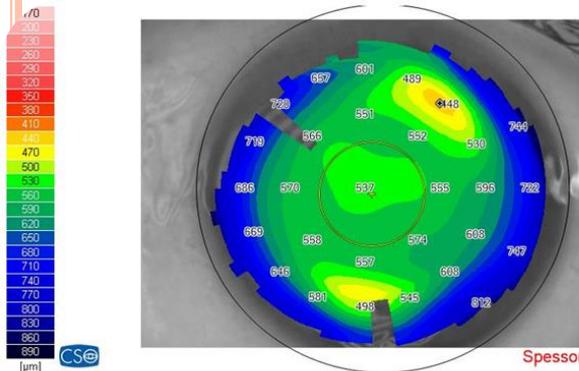
DSAEK 1 WEEK POST OP



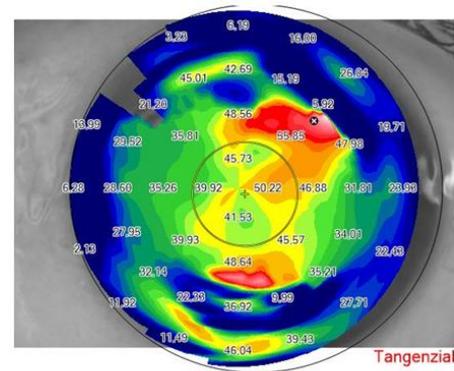
GRANULAR CORNEAL DYSTROPHY,
TYPE I







Spessore corneale



Tangenziale anteriore

OS
 Data di nascita: 09/10/1947
 Codice di identificazione: P0327103199
 Acquisizione: 16/09/2016 09:13:00 [#1-1]

Qualità dell'acquisizione

Adericit  corneale

$\phi = 6.0 \text{ mm}$

Anteriore
 $r_f = 42.47 \text{ D Ax } 127^\circ$ p = 1.58
 $r_s = 45.56 \text{ D}$
 RMS/A: 0.44 $\mu\text{m}/\text{mm}^2$

Posteriore
 $r_f = -5.87 \text{ D Ax } 72^\circ$ p = 0.92
 $r_s = -6.11 \text{ D}$
 RMS/A: 0.58 $\mu\text{m}/\text{mm}^2$

$\phi = 8.0 \text{ mm}$

Anteriore
 $r_f = 42.48 \text{ D Ax } 145^\circ$ p = 1.18
 $r_s = 45.58 \text{ D}$
 RMS/A: 0.41 $\mu\text{m}/\text{mm}^2$

Posteriore
 $r_f = -5.86 \text{ D Ax } 68^\circ$ p = 1.11
 $r_s = -5.95 \text{ D}$
 RMS/A: 0.53 $\mu\text{m}/\text{mm}^2$

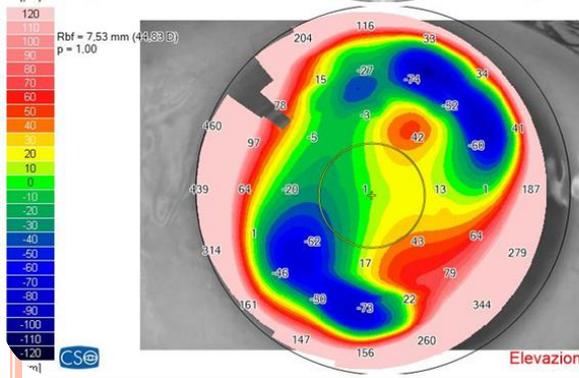
Analisi refrattiva

$\phi = 4.0 \text{ mm}$

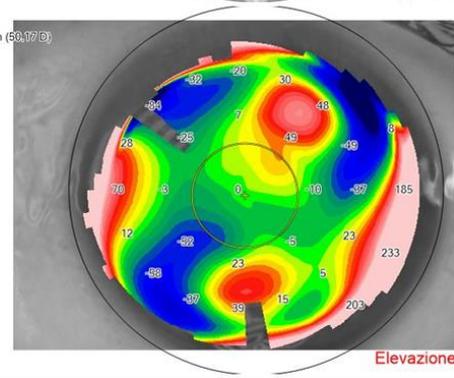
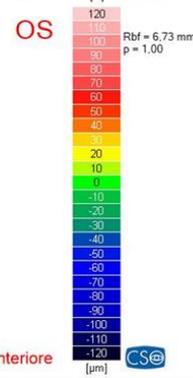
Cyl = -6.19 D Ax 104°
 Potere Pupillare Medio = 45.25 D
 LSA 0.25 D

Screening del cheratocono

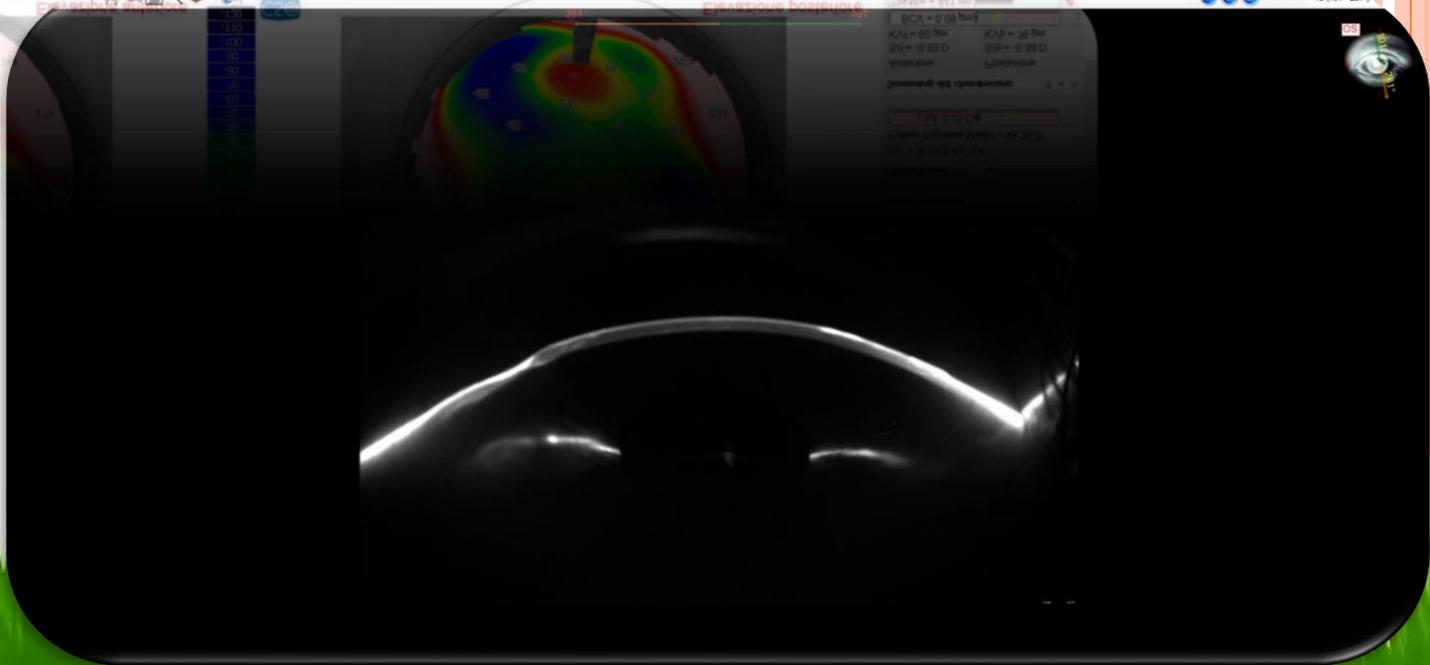
Anteriore	Posteriore
Sif = -0.93 D	Sib = -0.88 D
KVf = 60 μm	KVb = 76 μm
BCV = 0.09 μm	
ThkMin = 441 μm	

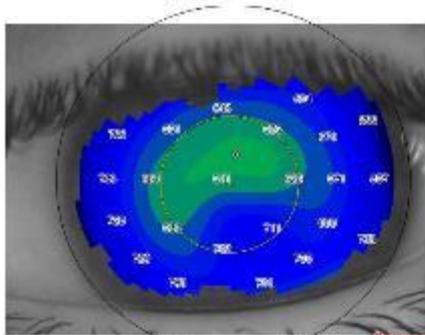


Elevazione anteriore

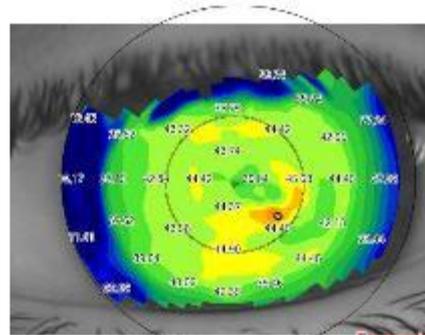


Elevazione posteriore

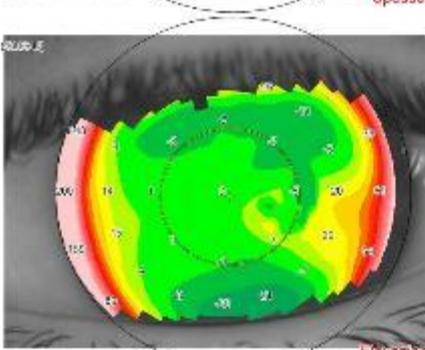




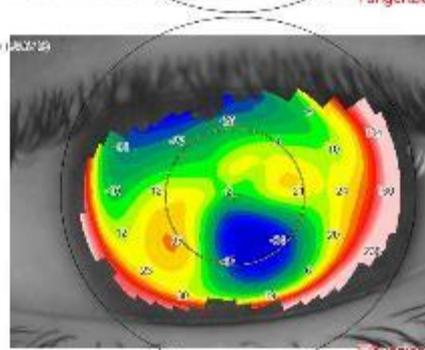
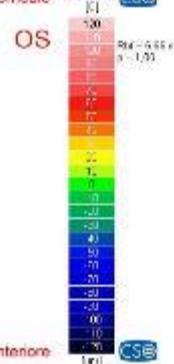
Spessore corneale



Tangenziale anteriore



Elevazione anteriore



Elevazione posteriore

cinino, giuseppe - OS
 Data di nascita: 19/11/1982
 Codice di dell'occhio: 1602161040
 Anzianità: 20/06/2014 08:00:00 [p] - 0

Qualità dell'acquisizione

Area riferita

0 - 6 mm

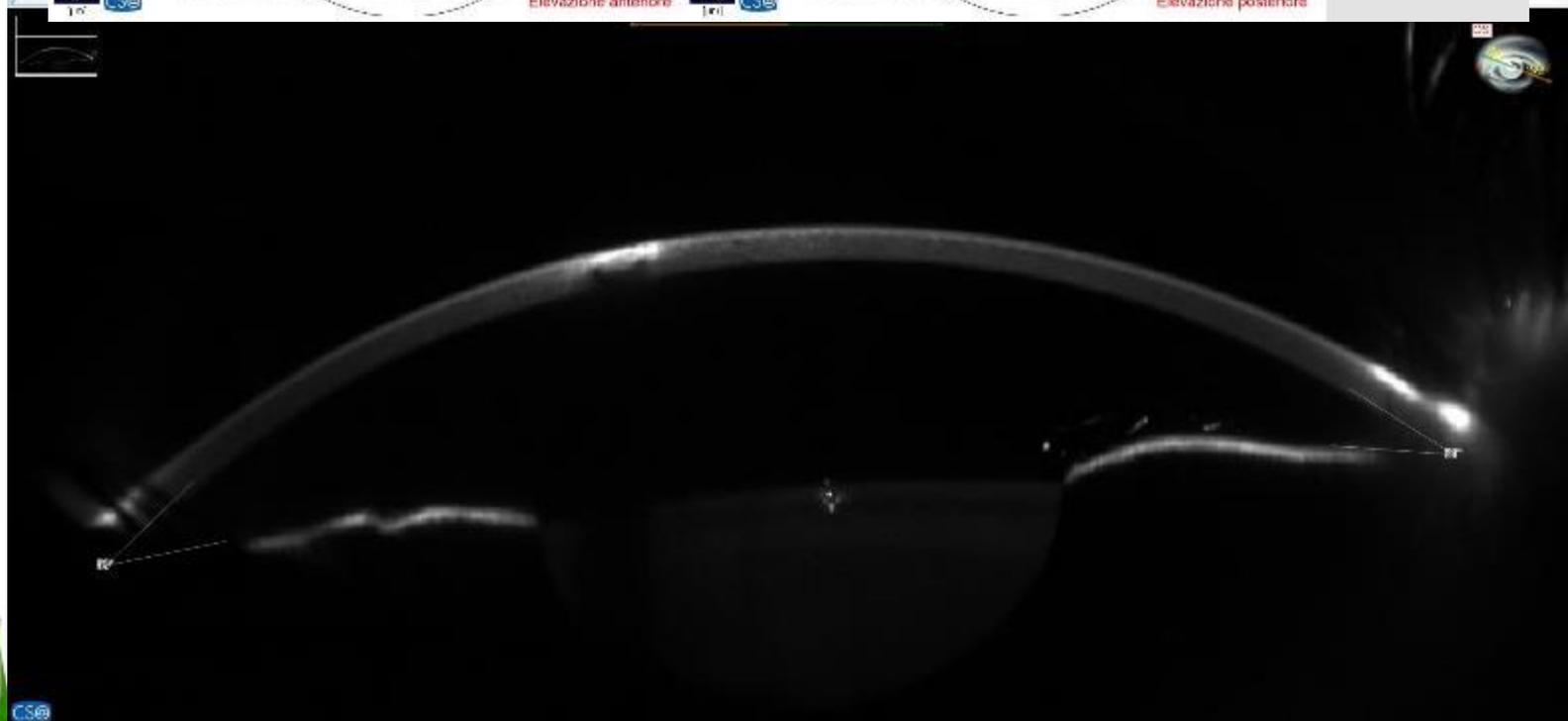
Ciclo: 1.00 OAc 124
 Posiz. Pupill. Medio: 41.21 D
 1.8x 7.51

Sequenza del rilevamento

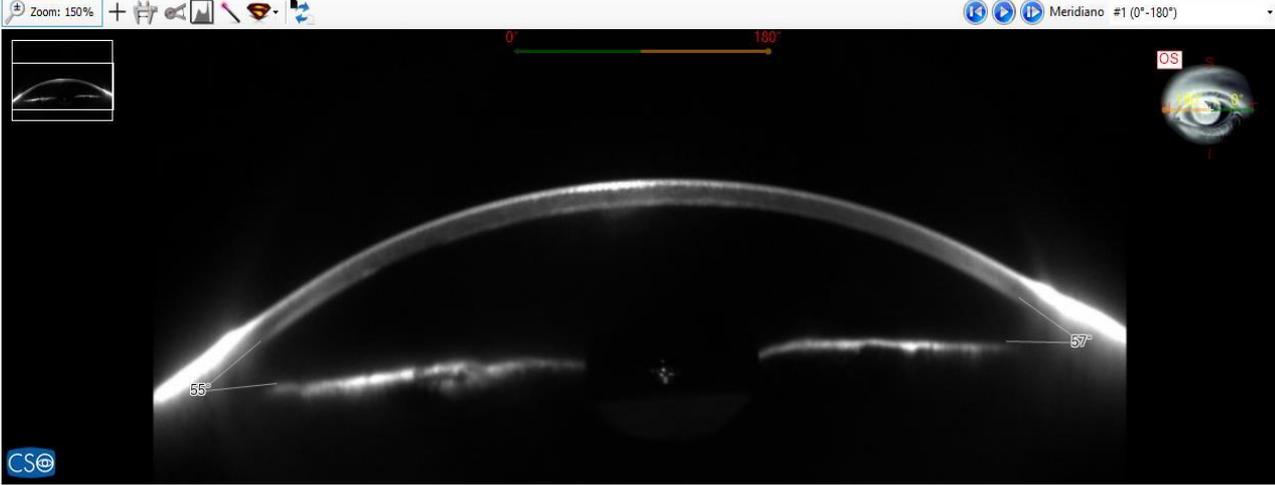
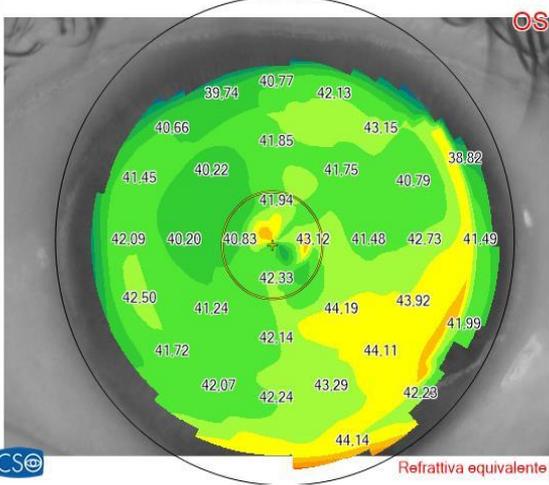
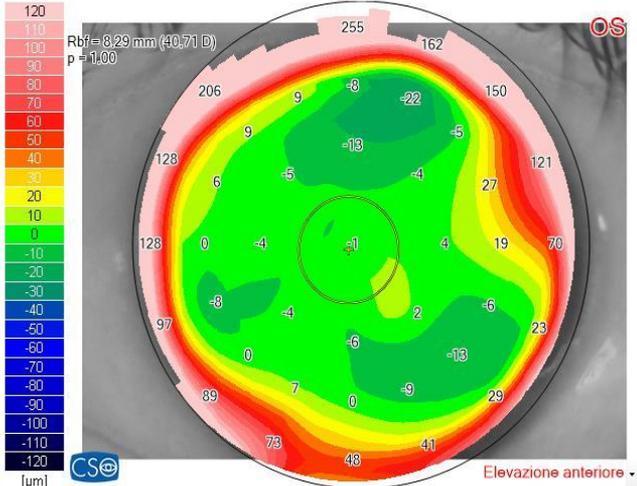
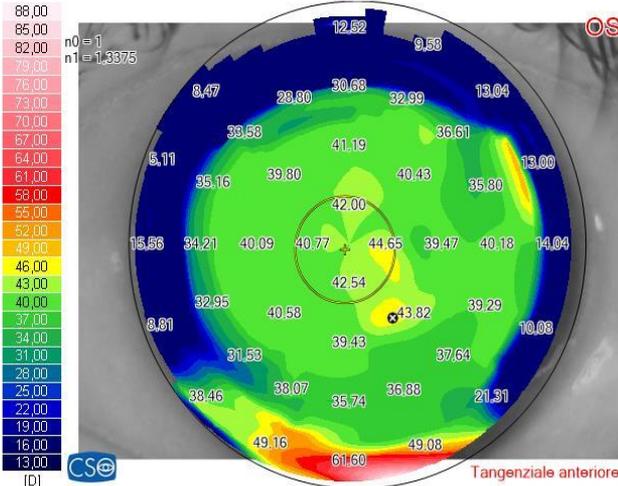
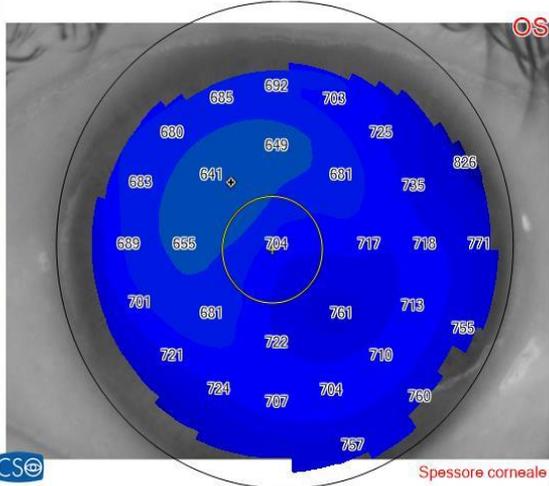
Asse X	Posizione
SP = 0.40 D	SP = -1.35 D
CV = 3.00	CV = 2.00
CV = 1.25 μ m	
1.00 μ m = 0.01	

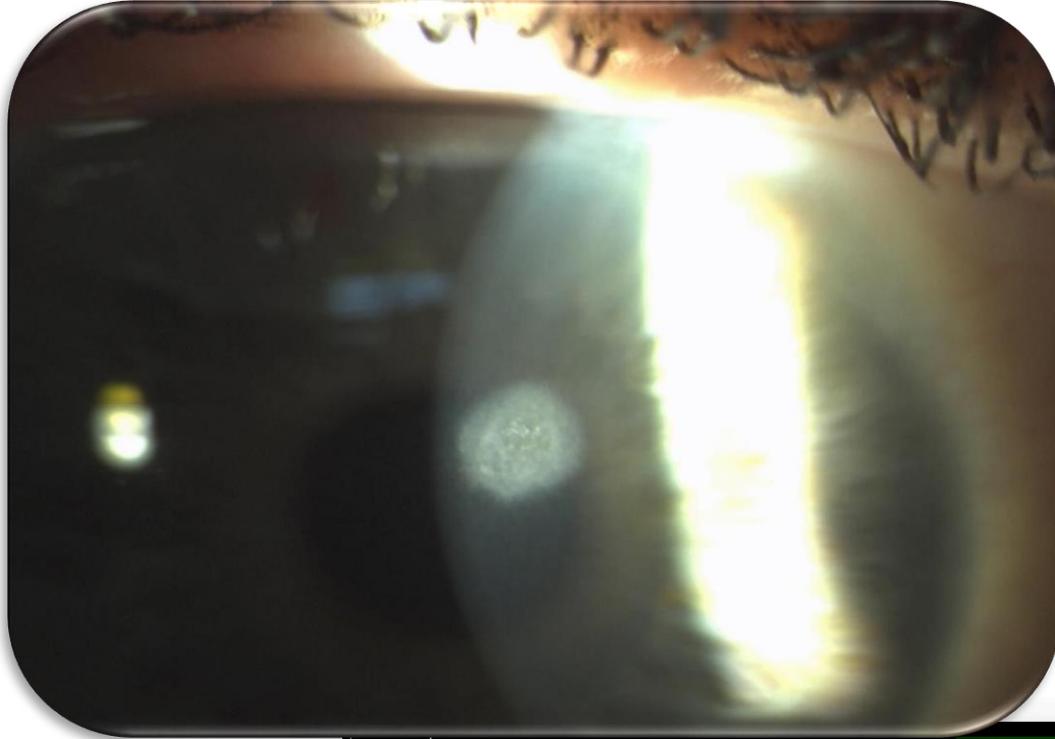
Posiz. dell'occhio: 41.21 D

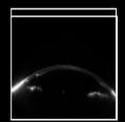
Sequenza di rilevamento



0
10
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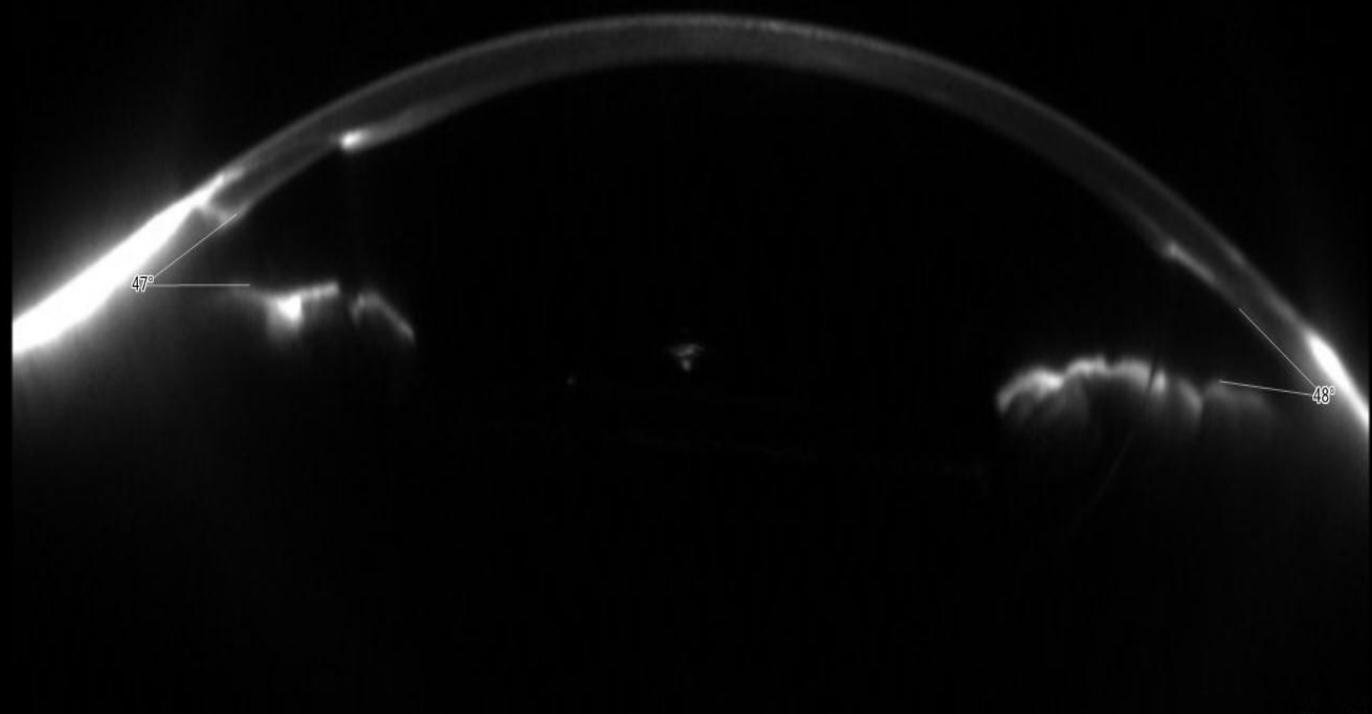




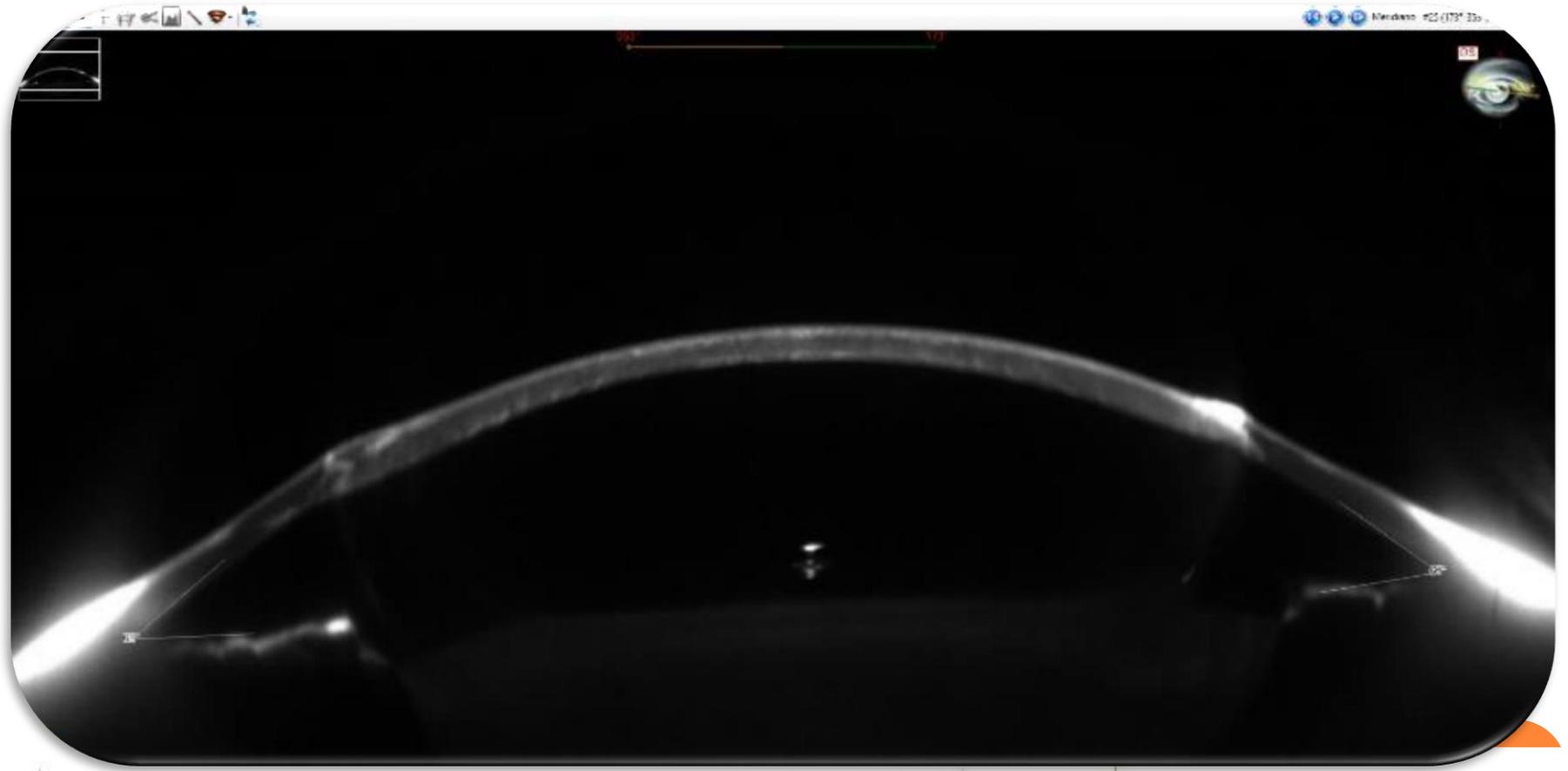


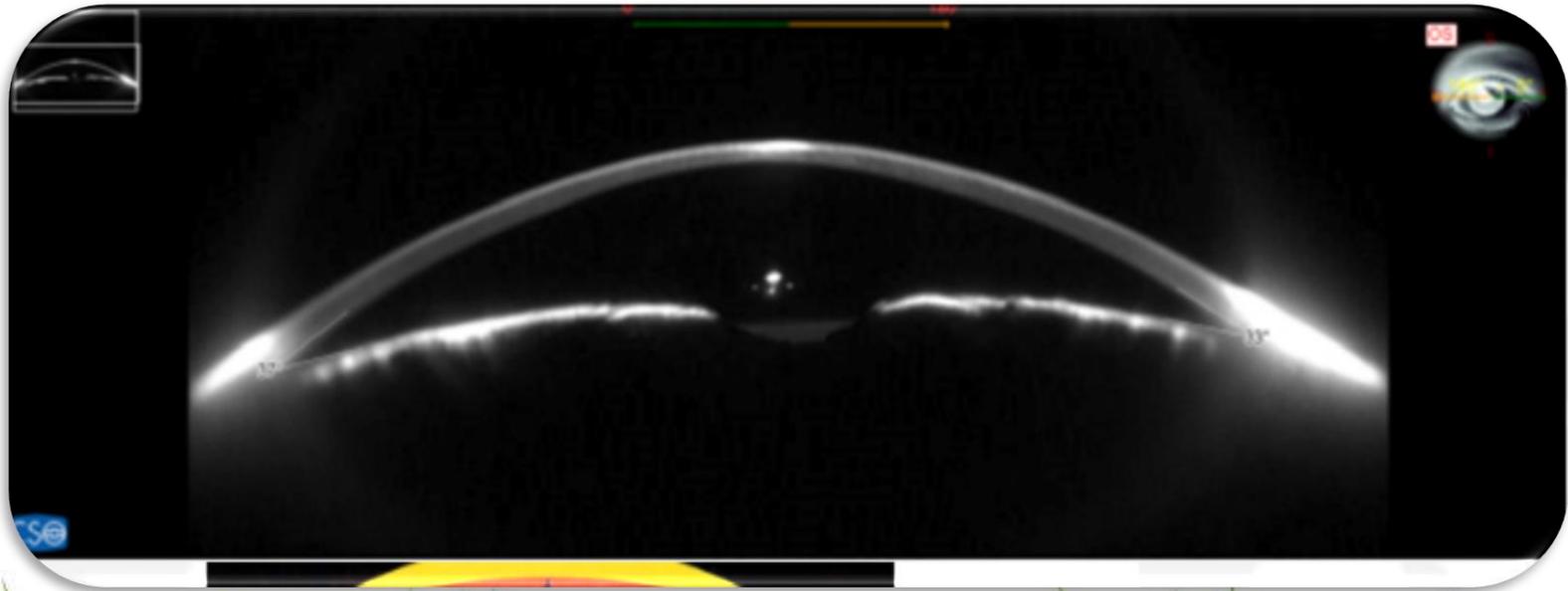
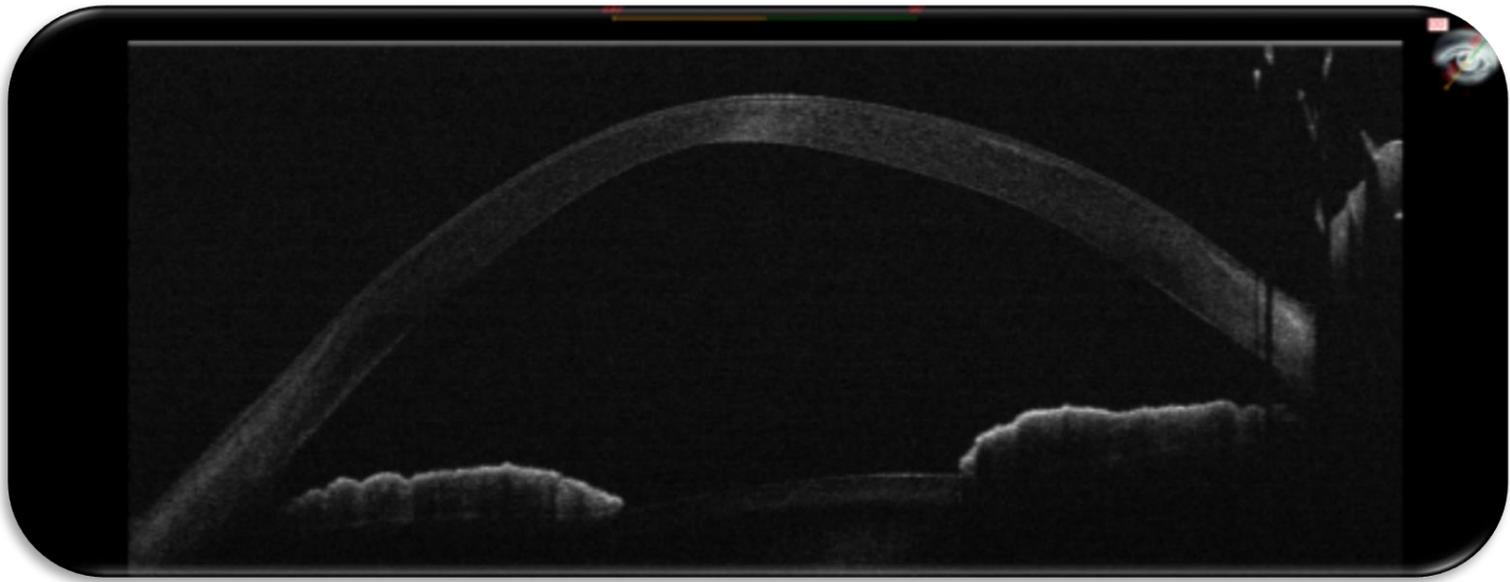
Dsaek

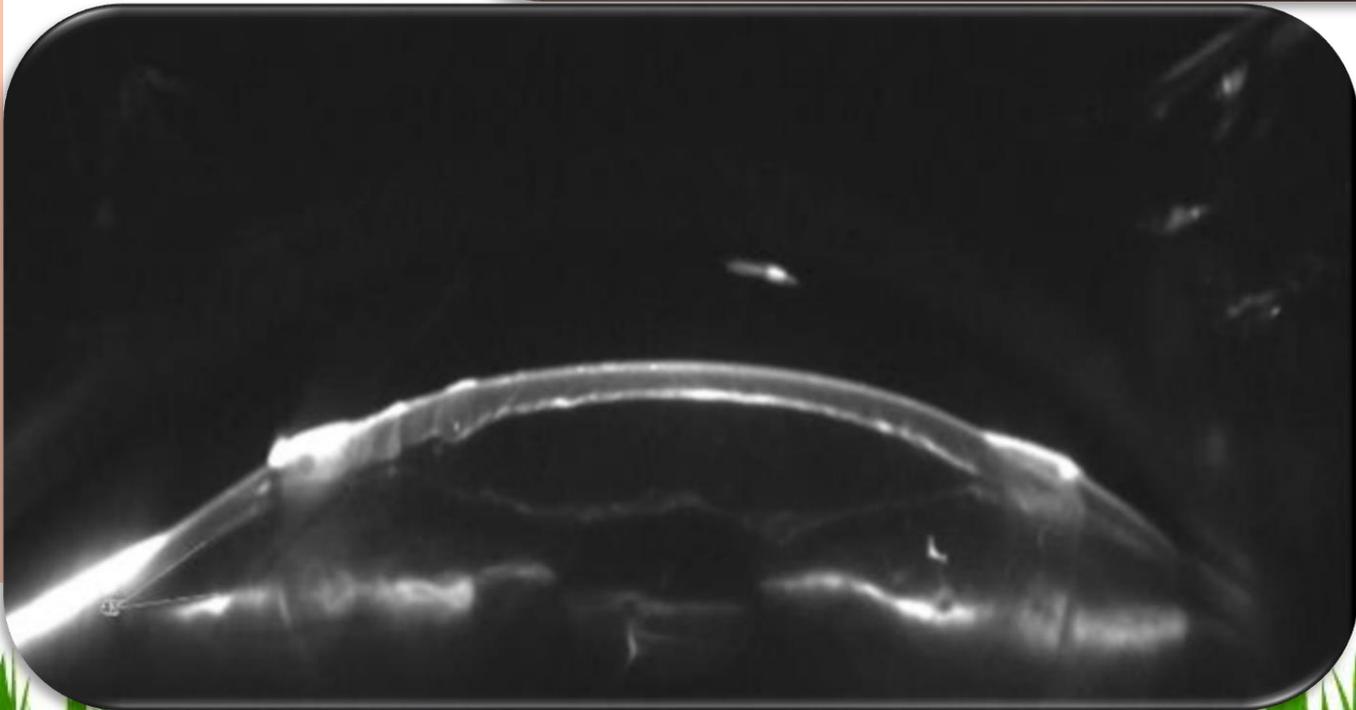
6 mesi post-op



DALK

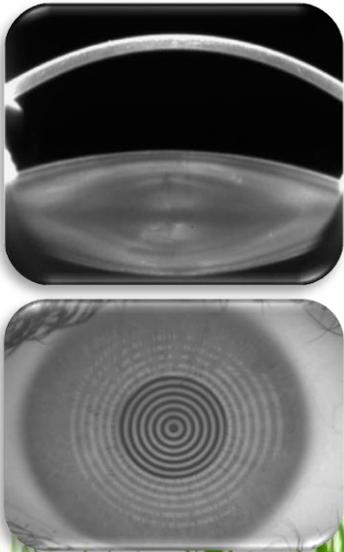






SIRIUS

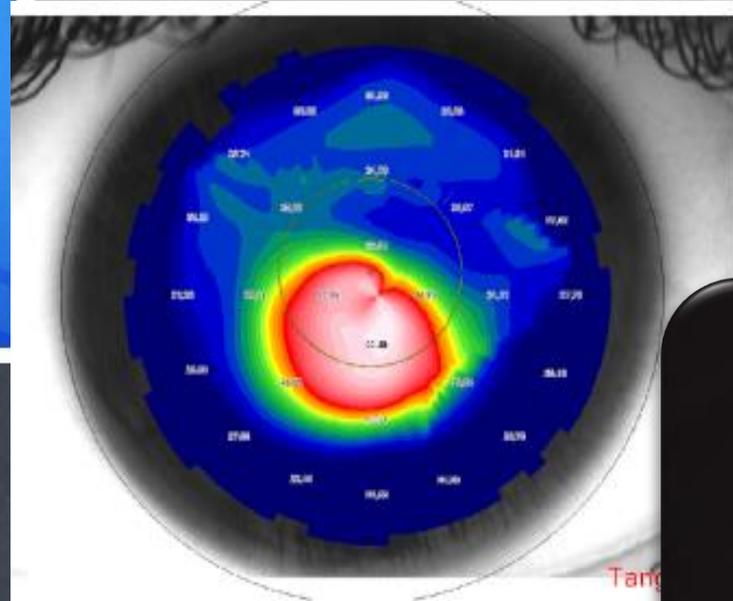
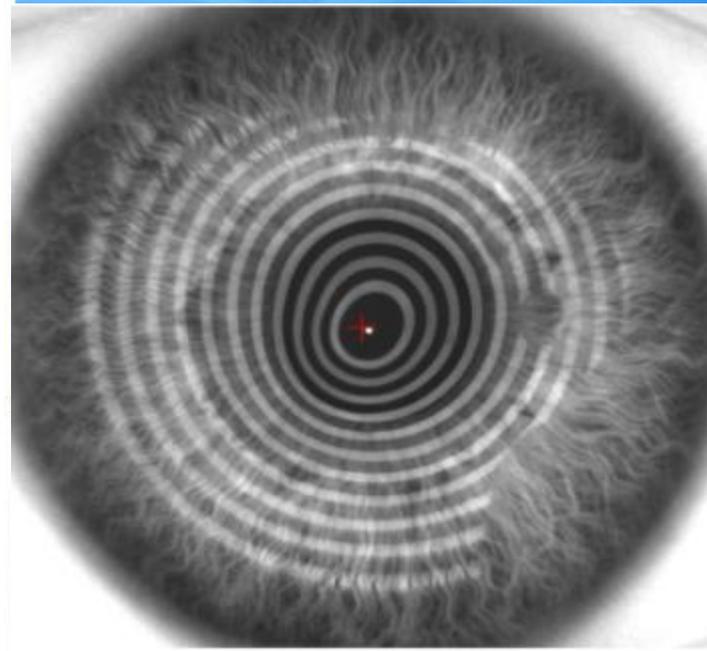
- Integrazione delle due tecnologie
- Arc-Step (disco di Placido)
- Scheimpflug camera
 - misurazioni accurate
 - curvature e poteri corneali



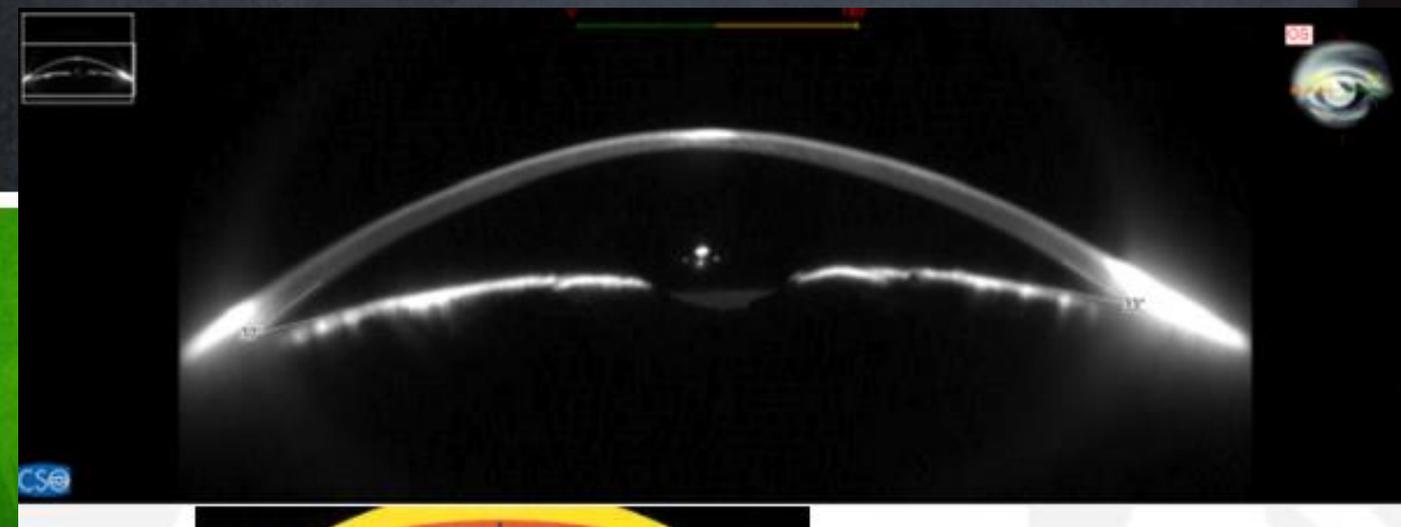
Dati morfologici camera anteriore



CHERATOCONO



OD



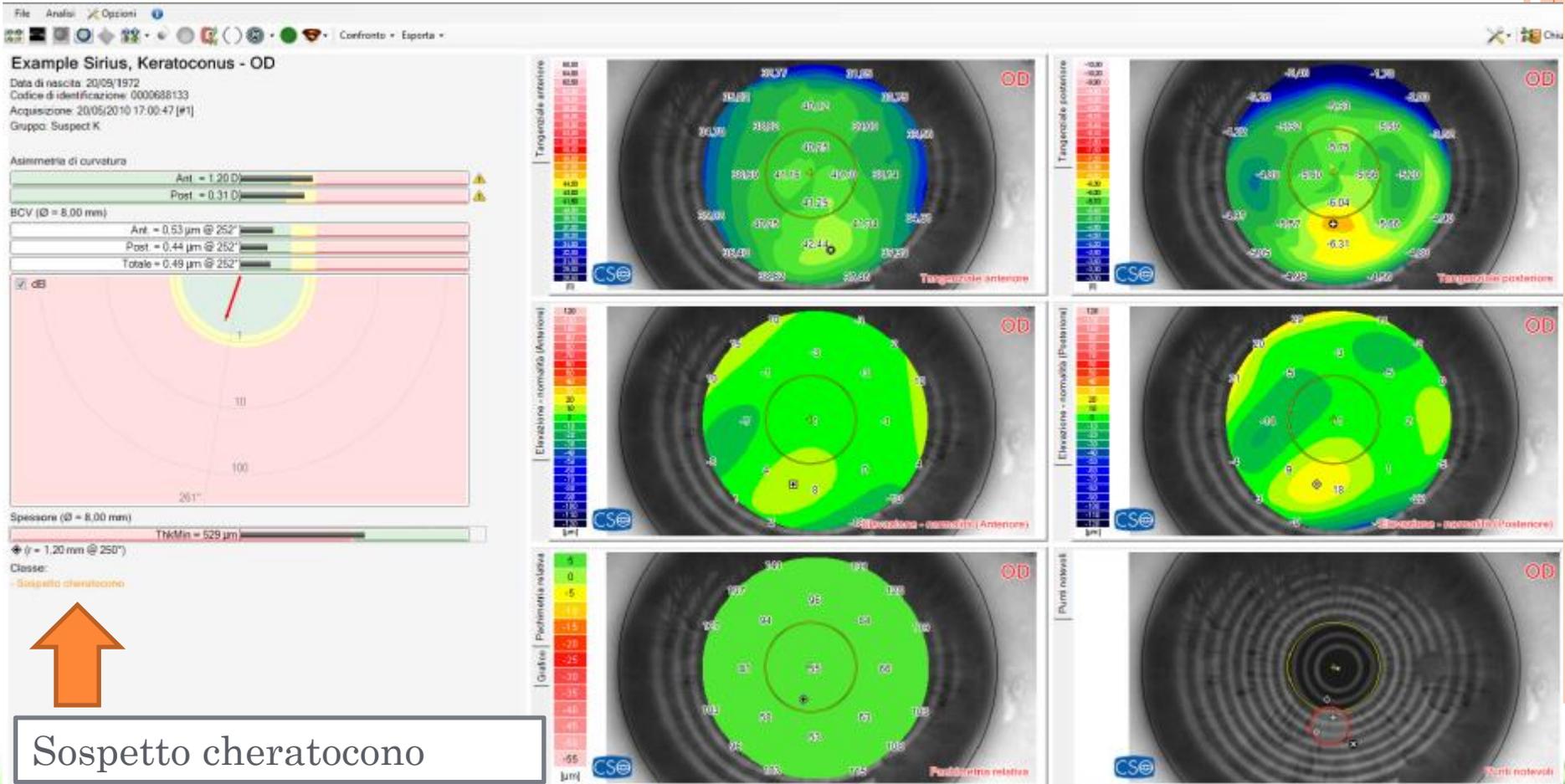
Classificazione del Cheratocono

The Amsler-Krumeich classification¹ includes the following stages:

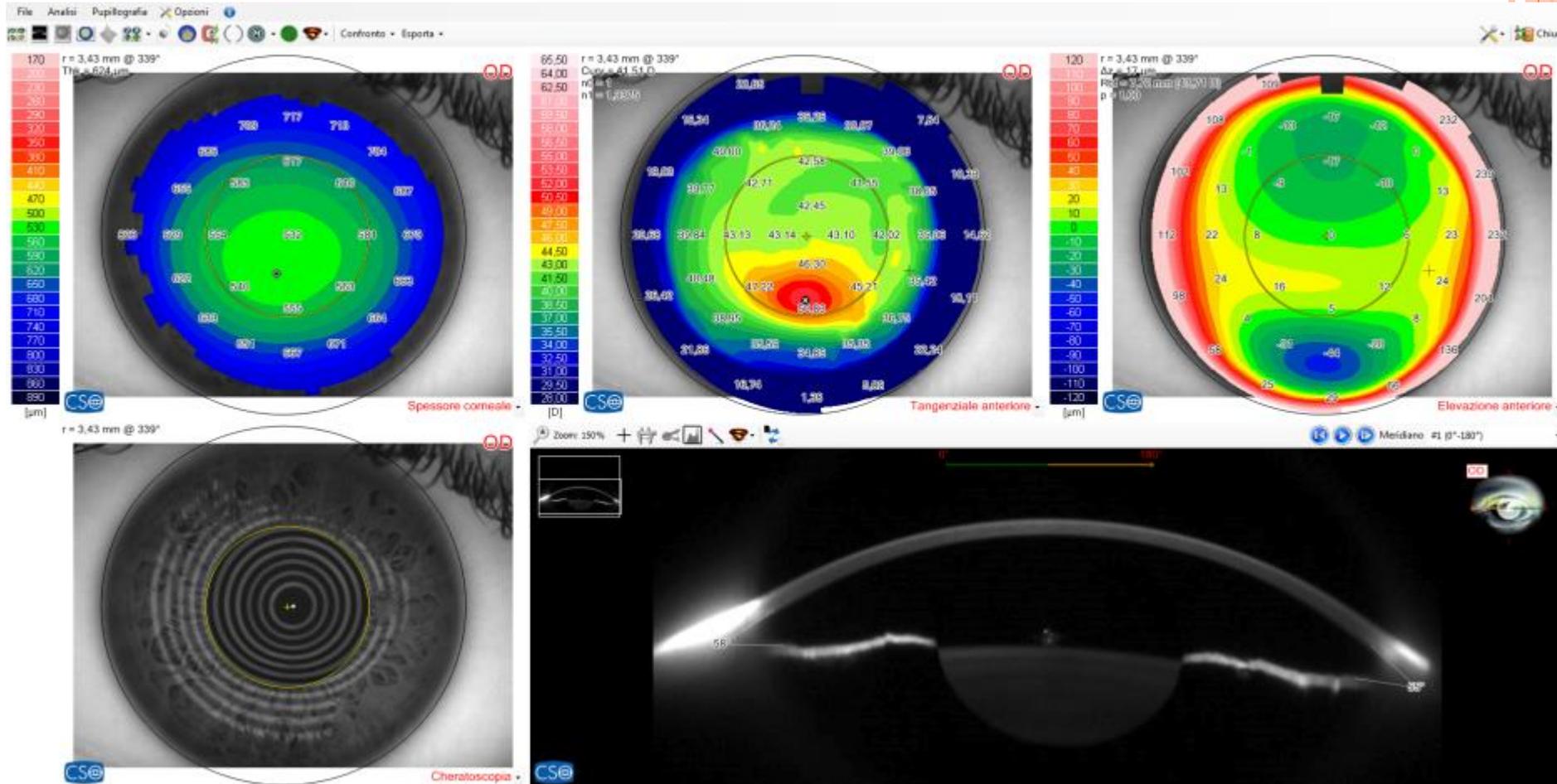
	Refrazione (Miopia ed astigmatismo indotti)	Astigmatismo (Lettura media dei K centrali)	Leucomi	Pachimetria (Spessore corneale Minimo)	Coma
Stage I	Dall'eccentricità del meridiano più curvo ad un difetto di < 5.00 D	<48.00 D	Assenza di leucomi	normale	RMS o COMA-LIKE tra 0,25 a 1,23µm
Stage II	Tra le 5.00 e 8.00 D	< 53.00 D	Assenza di leucomi	>400 µm	RMS o COMA-LIKE tra 1,23 e 1,50µm
Stage III	Tra 8.00 e 10.00 D	>53.00 D	Assenza di leucomi	tra 300 e 400 µm	RMS o COMA-LIKE tra 1,5 a ≤ 2,5µm
Stage IV	Refrazione non misurabile	> 55.00 D	Presenza di leucomi	Minimo 200 µm	RMS o COMA-LIKE >2,5µm

1) Alió Jorge, Corneal Higher Order Aberrations: A Method to Grade Keratoconus. J Refract Surg. Vol. 22 No. 6 June 2006 - la coma è stata proposta dal dott. Mularoni A.

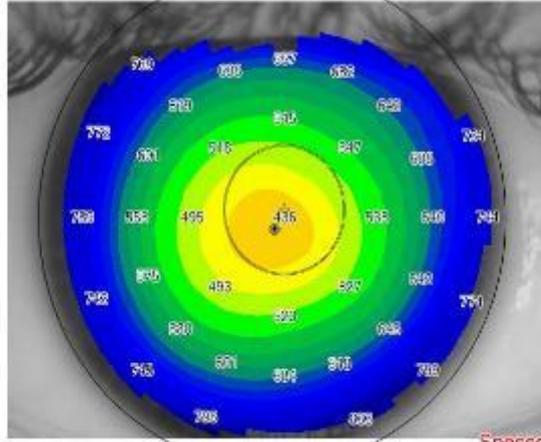
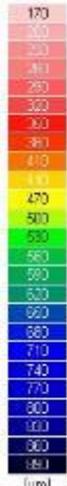
Cheratocono Sospetto



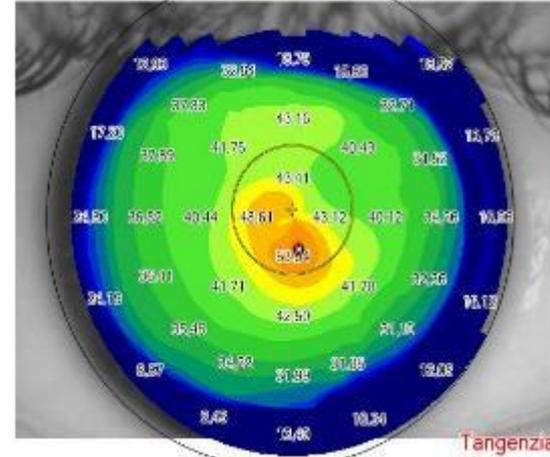
1° Stadio Amsler-Krumeich



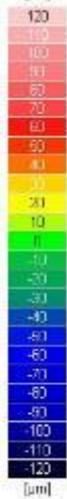
2° STADIO AMSLER-KRUMEICH



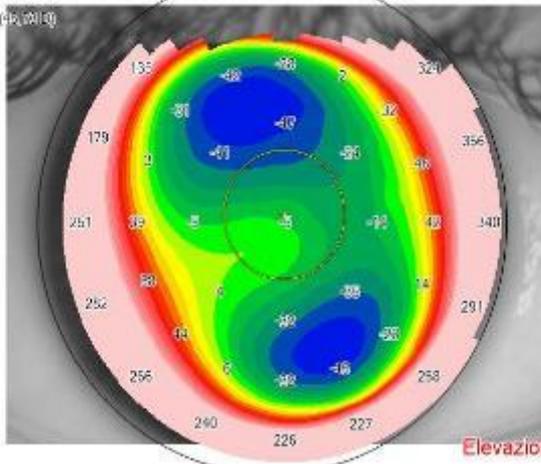
OD



OD



Rbf = 7.38 mm (45/04) 0
p = 1.00

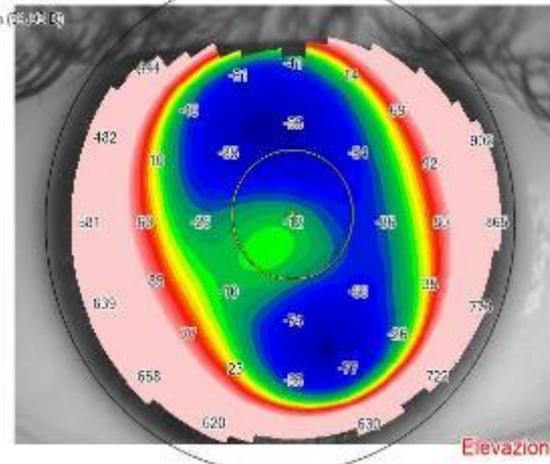


Elevazione anteriore

OD



Rbf = 6.14 mm (28/04) 0
p = 1.00



Elevazione posteriore

OD

morelli, mattia - OD
 Data di nascita: 28/04/1991
 Codice di identificazione: P0447033838
 Autocollante: 30/09/2016 11:43:58 (#1-1)

Qualità dell'acquistazione

Analisi refrattiva

Ø = 4.0 mm
 Cyl = -3.96 D Ax 28°
 Potere Pupillare Medio = 46.33 D
 LSA = -1.46 D

Screening del cheratocono

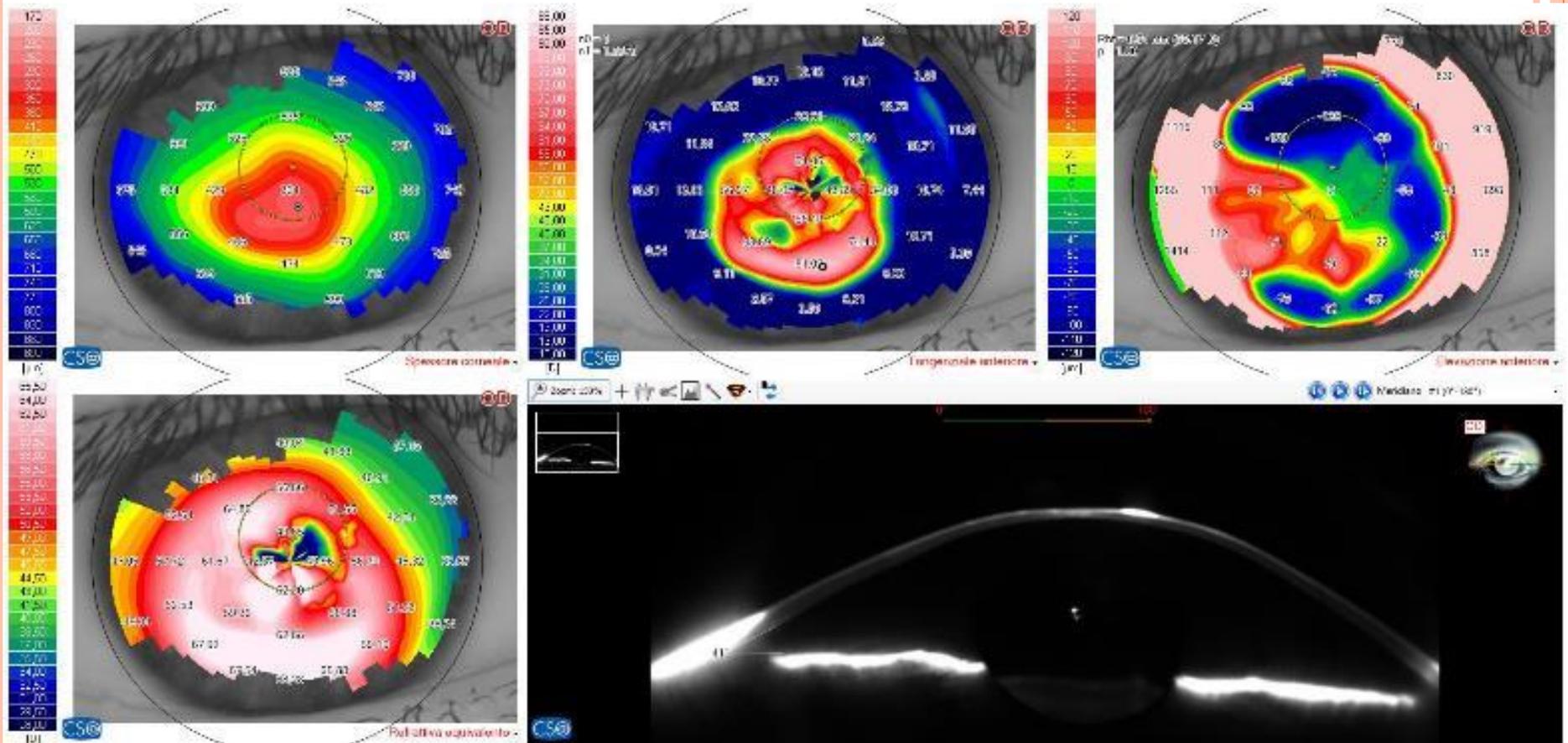
Anteriore	Posteriore
Sit = 4.07 D	(Sit) = 1.05 D
KVf = 22 µm	(KVf) = 50 µm
BCV = 2.20 µm	
TKMn = 431 µm	

Classe
 Compatibile con cheratocono

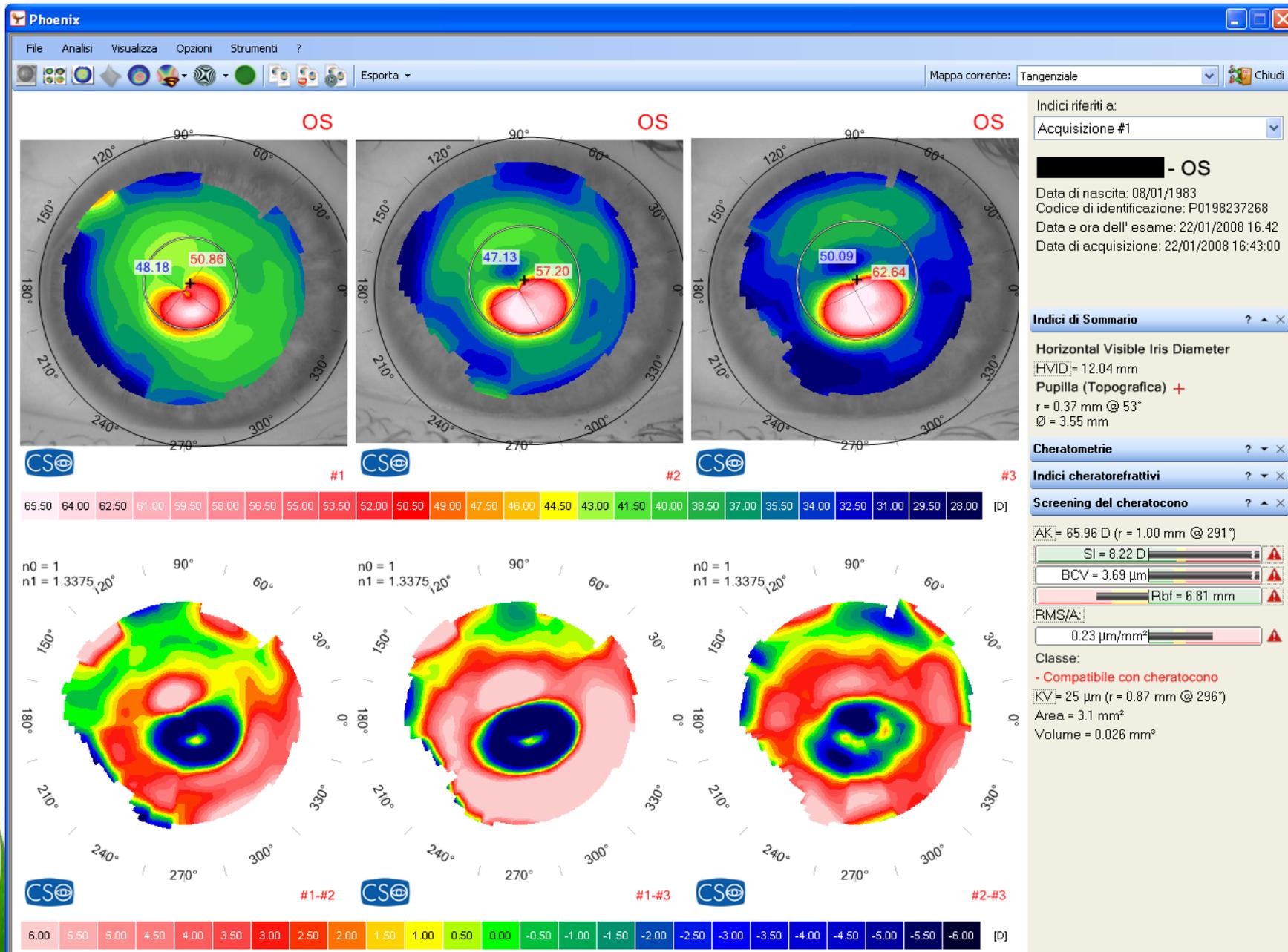
[Sommario del cheratocono](#)



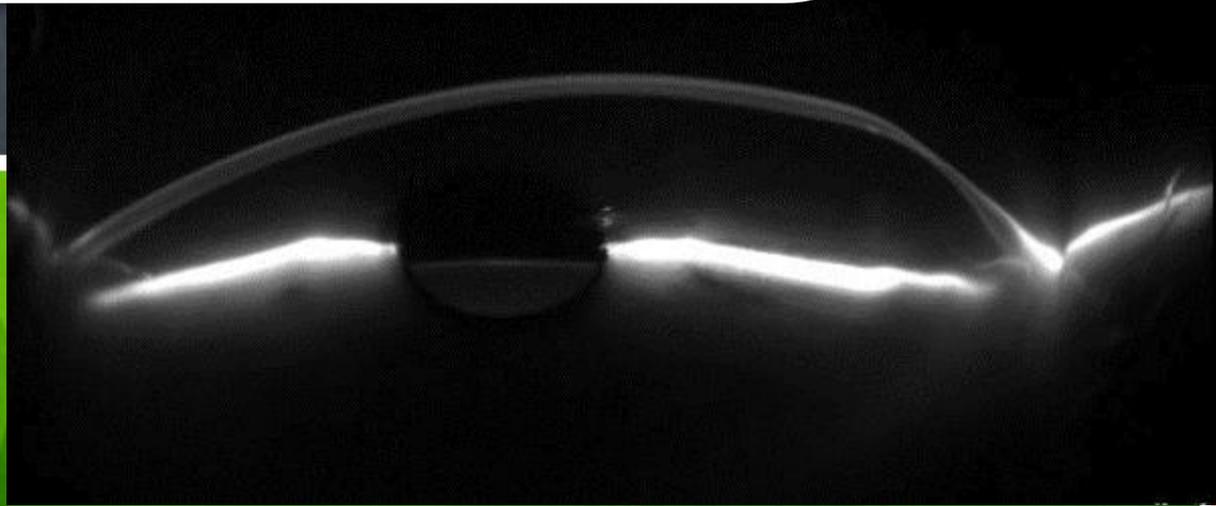
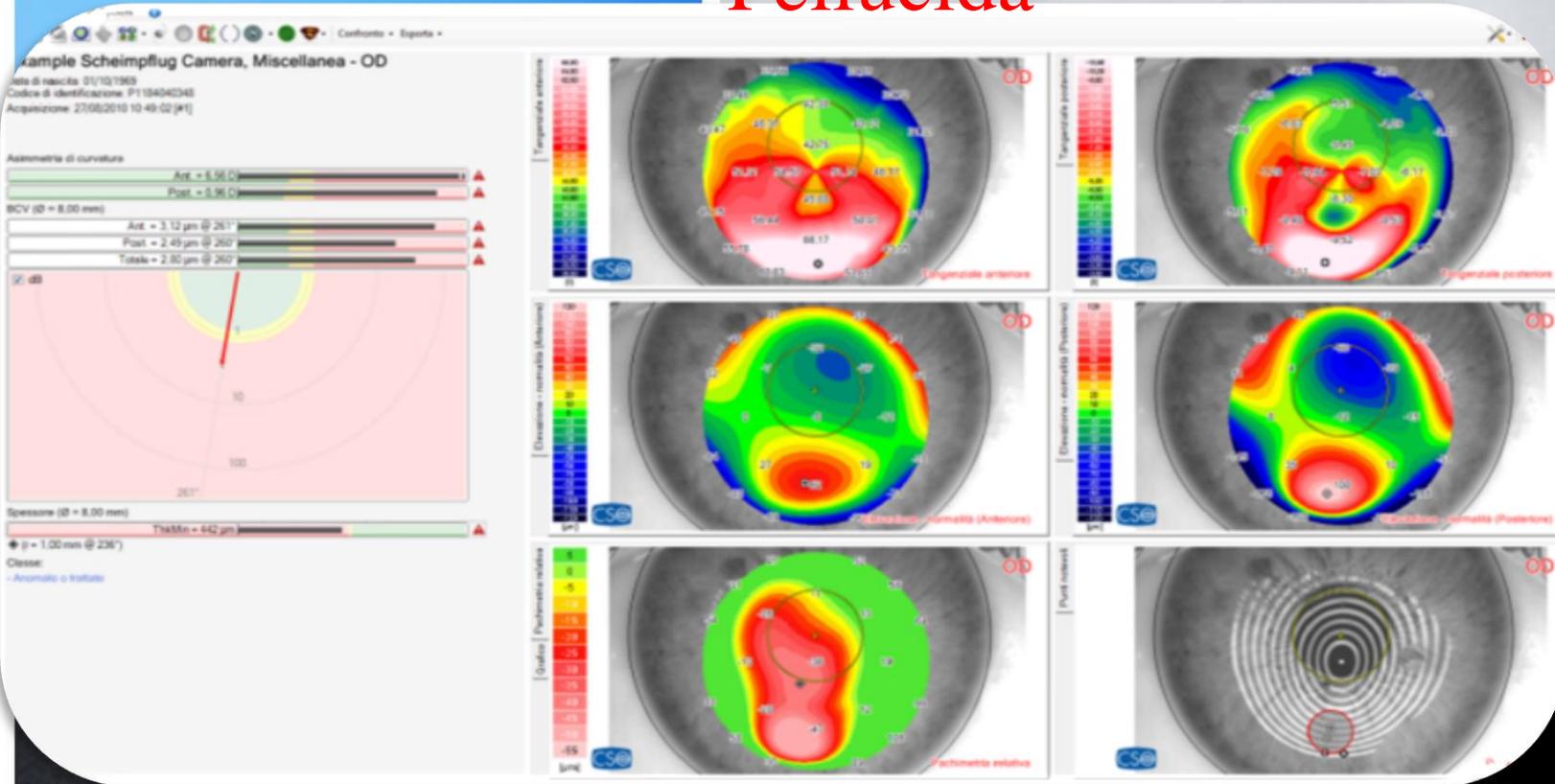
3° Stadio Amsler-Krumeich



Follow-up



Pellucida



La aberrazioni

Topografia corneale → **morfologia corneale**

Aberrometria → **aberrazioni del fronte d'onda**

Aberrometri

1. Valutano la dispersione del fuoco utilizzando polinomi di Zernike
2. Ricostruiscono il “fronte d’onda” e lo scompongono ricavando quello determinato da ogni singola aberrazione.
3. Le distorsioni corneali influenzano sempre il fronte d’onda oculare in maniera più significativa di qualsiasi altra interfaccia

ABERROMETRIA CORNEALE

1. componente più rilevante
2. stabile
3. facilmente misurabile

Le aberrazioni corneali sono le dominanti fino a 40/50 anni e soprattutto nelle ectasie e in chirurgia refrattiva.



7 Aberrazioni di Seidel

aberrazione cromatica (si verifica anche nella regione parassiale)

aberrazioni monocromatiche (si verificano fuori la regione parassiale)

astigmatismo
sferica
coma

} Aberrazioni che sfuocano e diminuiscono il contrasto

distorsione

curvatura di campo di Petzval

} Aberrazioni che deformano le immagini



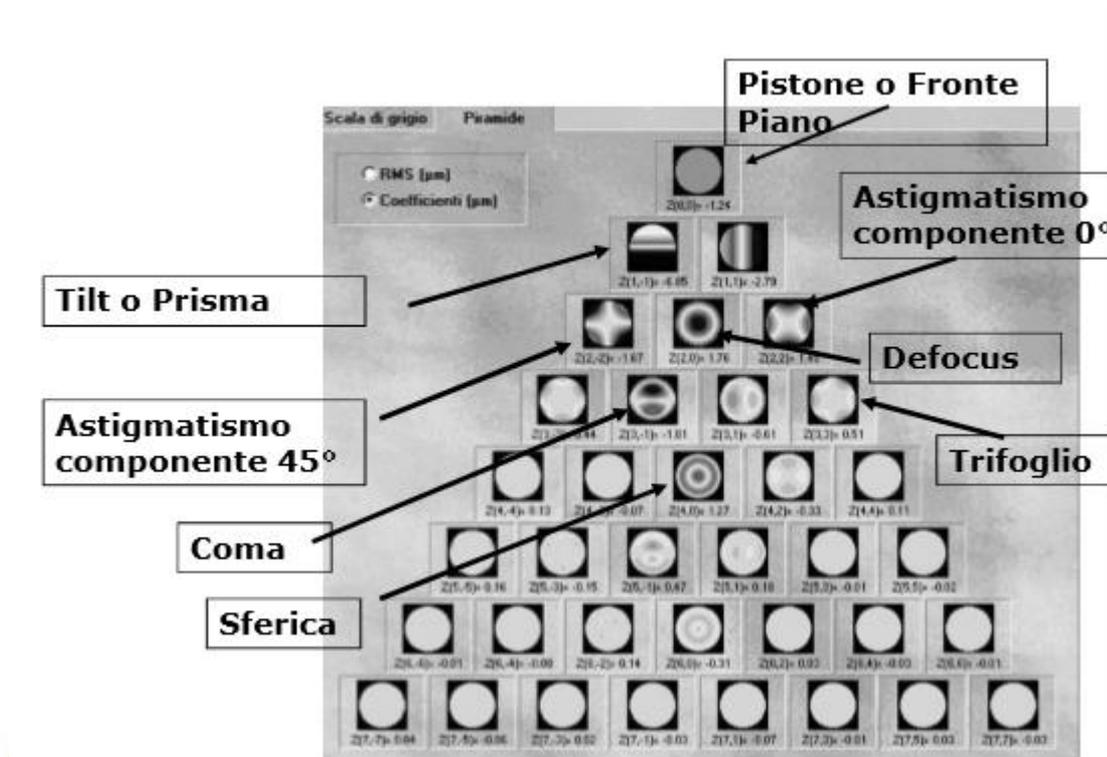
Analisi di Zernike

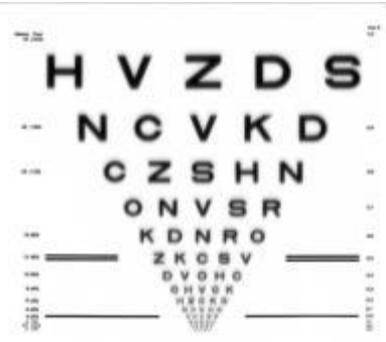
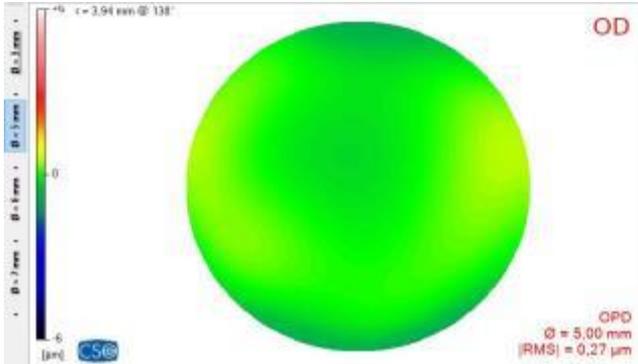
La serie di polinomi è in ordine crescente e potenzialmente infinita.

-Più polinomi si utilizzano più dettagliata è la rappresentazione della superficie analizzata

-I polinomi sono indipendenti l'uno dall'altro.

-Il peso di ogni singola componente può essere considerato indipendentemente



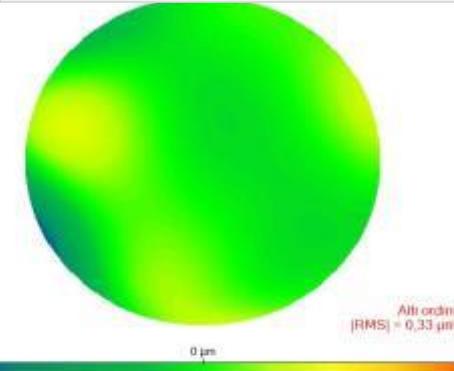
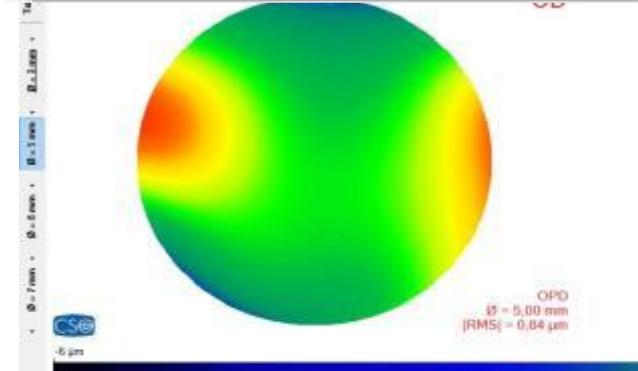
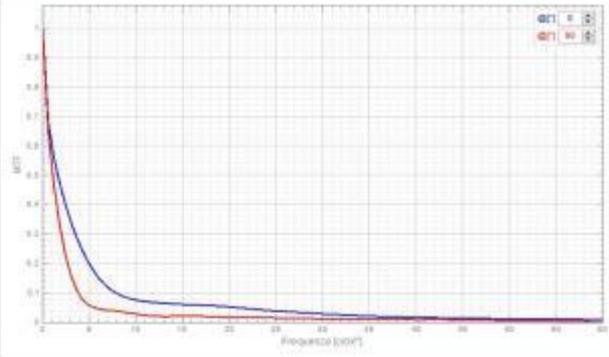
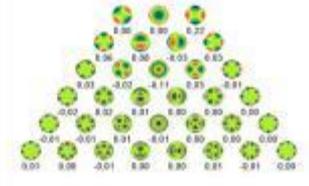


lorenzi, alberto - OD
 Data di nascita: 12/06/1961
 Codice di identificazione: P1347244603
 Acquisizione: 03/10/2015 10:46:56 (P1-1)

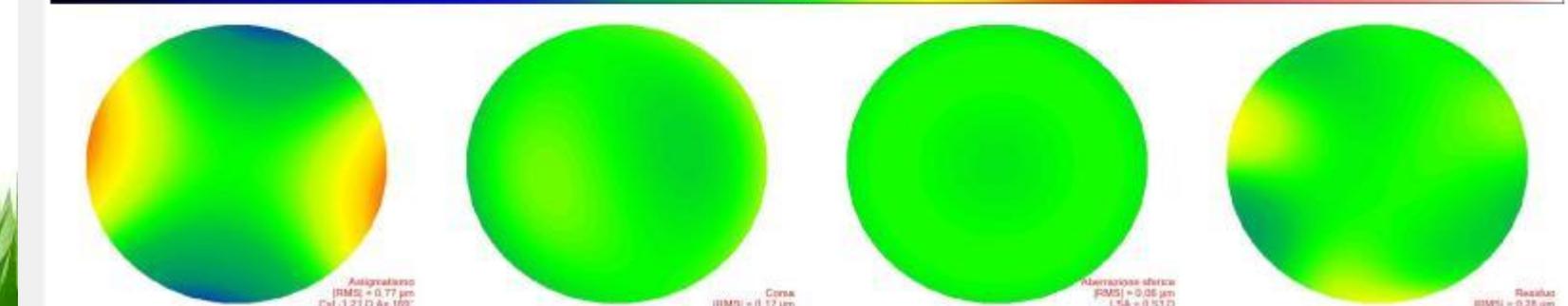
$\varnothing = 5.00 \text{ mm}$

	Sph [D]	Cyl [D]	As
@0 mm	+0.17	-0.34	0°
@12.5 mm	+0.17	-0.34	0°

Totale = 0,27 RMS [μm] LDA = 0,22 HDA = 0,17



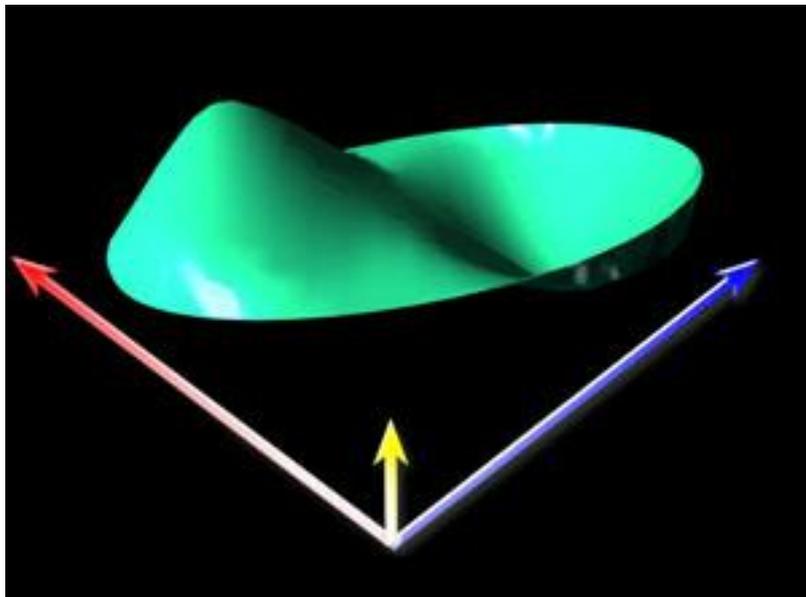
Z ₀ Trifoglio	0,22 μm @ 34°
Z ₀ Cono	0,17 μm @ 15°
Z ₀ Quadrifoglio	0,13 μm @ 79°
Z ₀ Astigmatismo II	0,05 μm @ 102°
Z ₀ Ab. sferica	0,06 μm
Z ₀ Pentafoglio	0,09 μm @ 23°
Z ₀ Trifoglio II	0,02 μm @ 90°
Z ₀ Cono II	0,02 μm @ 310°
Z ₀ Esafoglio	0,02 μm @ 47°
Z ₀ Quadrifoglio II	0,03 μm @ 27°
Z ₀ Astigmatismo II	0,01 μm @ 137°
Z ₀ Ab. sferica II	0,01 μm
Z ₀ Esafoglio II	0,02 μm @ 16°
Z ₀ Pentafoglio II	0,02 μm @ 30°
Z ₀ Trifoglio III	0,00 μm @ 104°
Z ₀ Cono III	0,01 μm @ 173°



COMA

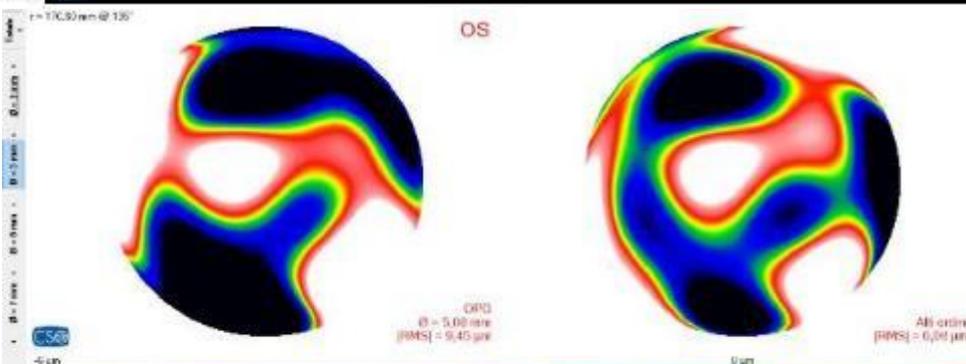
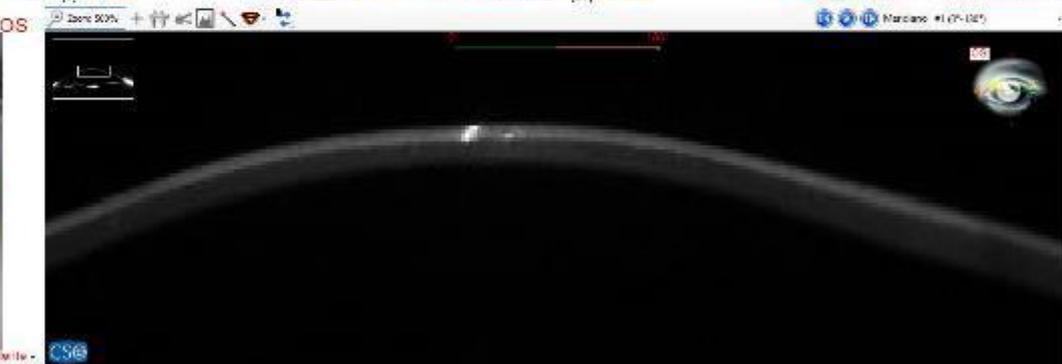
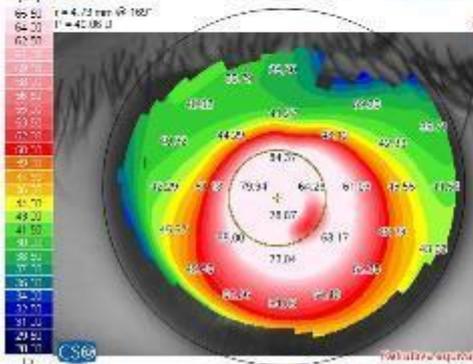
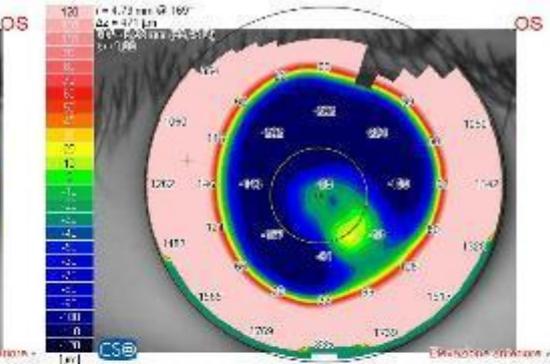
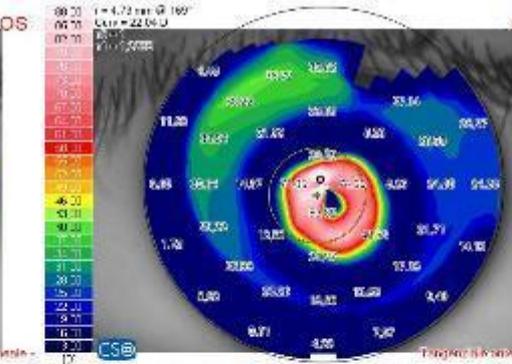
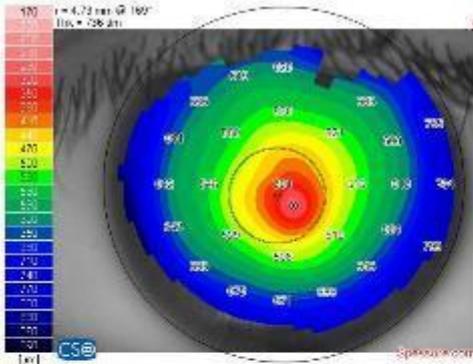
deriva

dall'aspetto a cometa dell'immagine

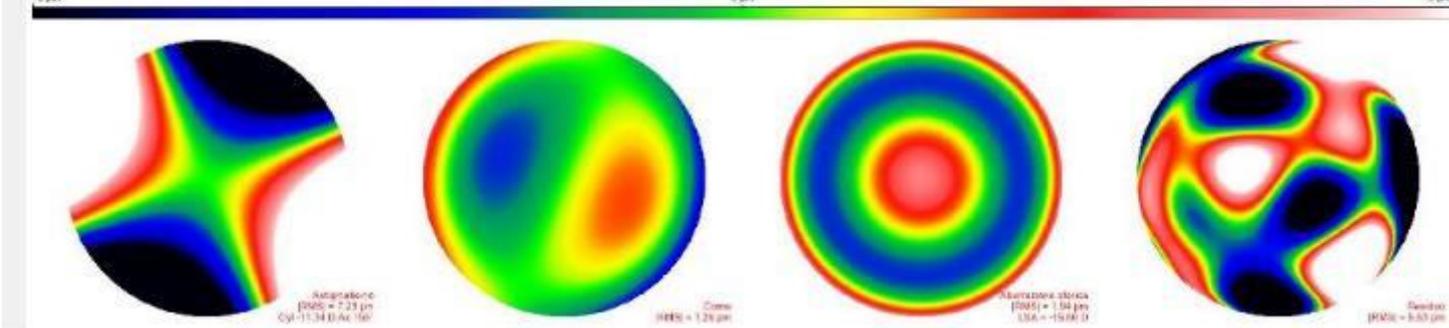


1. Raggi luminosi attraversano una superficie ottica che ha una superficie decentrata da un lato.
2. Punto di maggiore curvatura non coincide con l'asse ottico spostato perifericamente.
3. progressiva riduzione della curvatura verso la periferia, che però sarà più "ripida" da un lato rispetto all'altro.
4. punto di massima ed uno di minima curvatura, in posizioni diametralmente opposte.

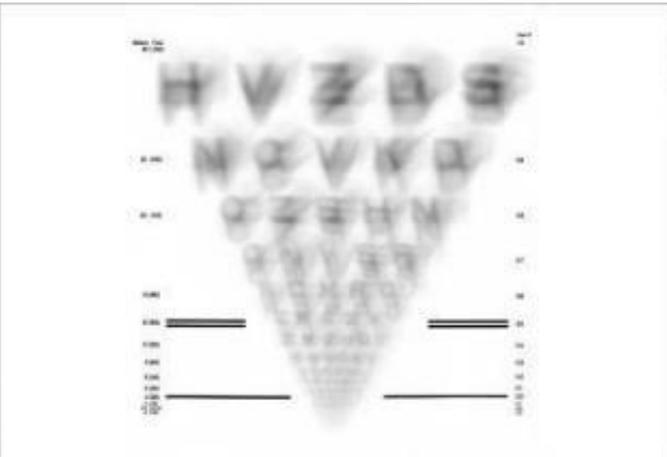
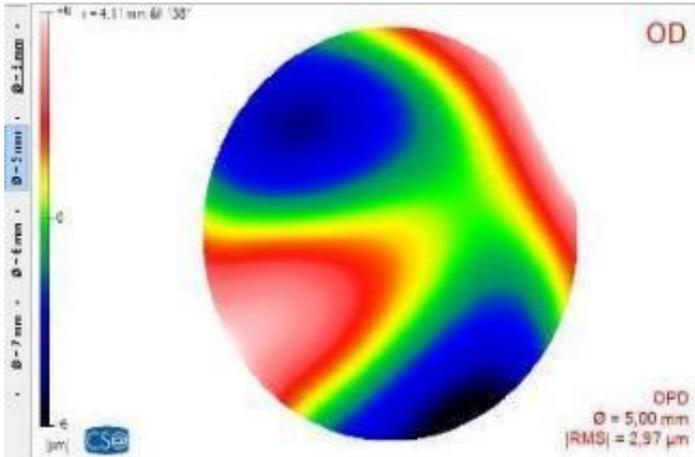




Z=Anagnorino	7.23 μm @ 162'
Z=Telajo	7.66 μm @ 162'
Z=Cone	7.28 μm @ 162'
Z=Quadrato	7.95 μm @ 162'
Z=Anagnorino II	7.56 μm @ 162'
Z=Ab. stacca	7.91 μm
Z=Parabolo	6.98 μm @ 162'
Z=Telajo II	6.97 μm @ 162'
Z=Cone II	7.97 μm @ 162'
Z=Kwighi	6.53 μm @ 162'
Z=Anagnorino II	6.87 μm @ 162'
Z=Ab. stacca II	7.18 μm @ 162'
Z=Cone II	7.03 μm @ 162'
Z=Cone II	6.56 μm @ 162'
Z=Parabolo II	6.57 μm @ 162'
Z=Telajo II	7.26 μm @ 162'
Z=Cone II	7.04 μm @ 162'

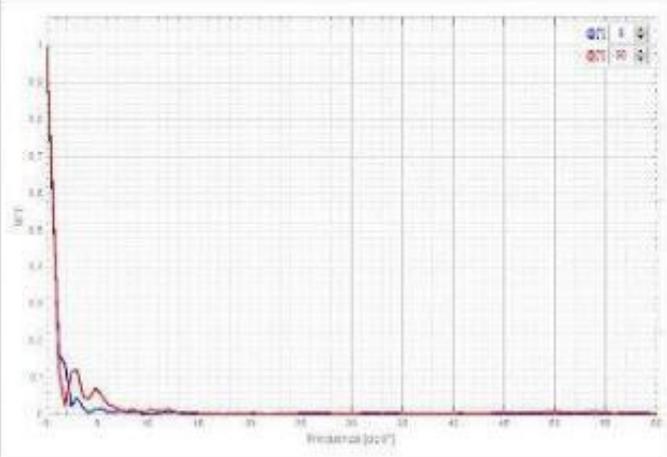
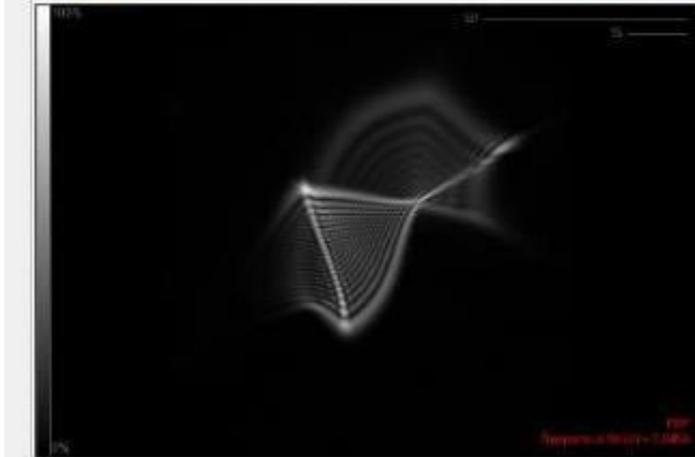
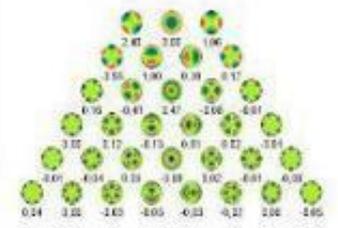


ANALISI QUALITA' VISIVA

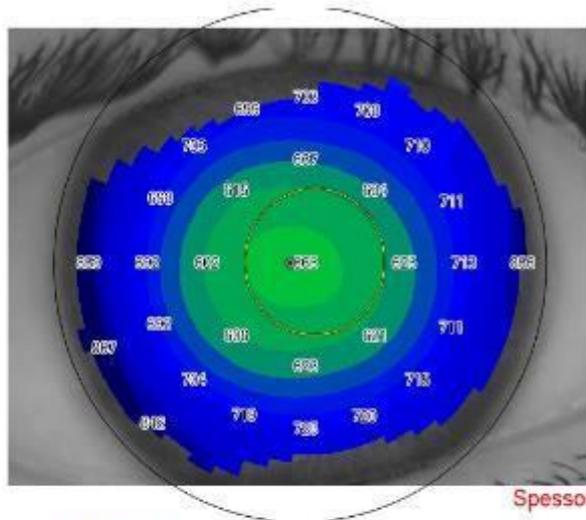


belli, ramona - OD
 Data di nascita: 25/01/1991
 Codice di identificazione: P0183319311
 Acquisizione: 18/05/2016 11:42:57 (RT-1)

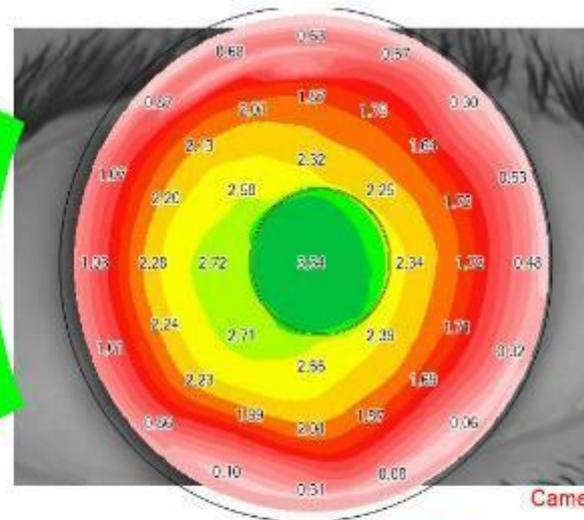
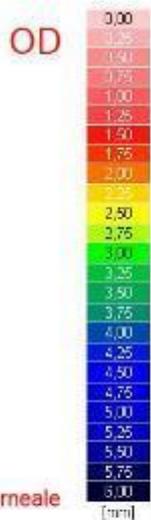
	$\Delta Z [\mu\text{m}]$	Δx
@6 mm	+2,85	4,11
@12,5 mm	+2,60	4,11
Totale = 2,97		
RMS [μm]		
LOA = 2,52		
HOA = 1,46		



STUDIO DEL GLAUCOMA



Spessore corneale



Camera anteriore

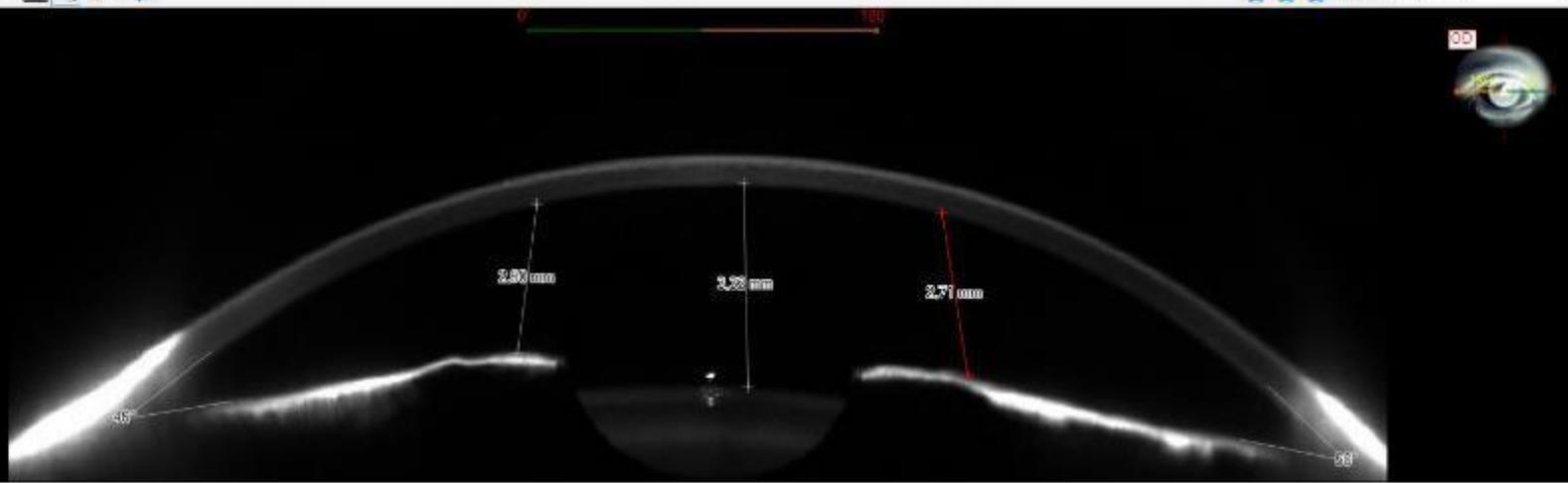
OD

barison, andrea - O
 Data di nascita: 11/01/1980
 Codice di identificazione: P12040
 Acquisizione: 21/09/2016 14:34

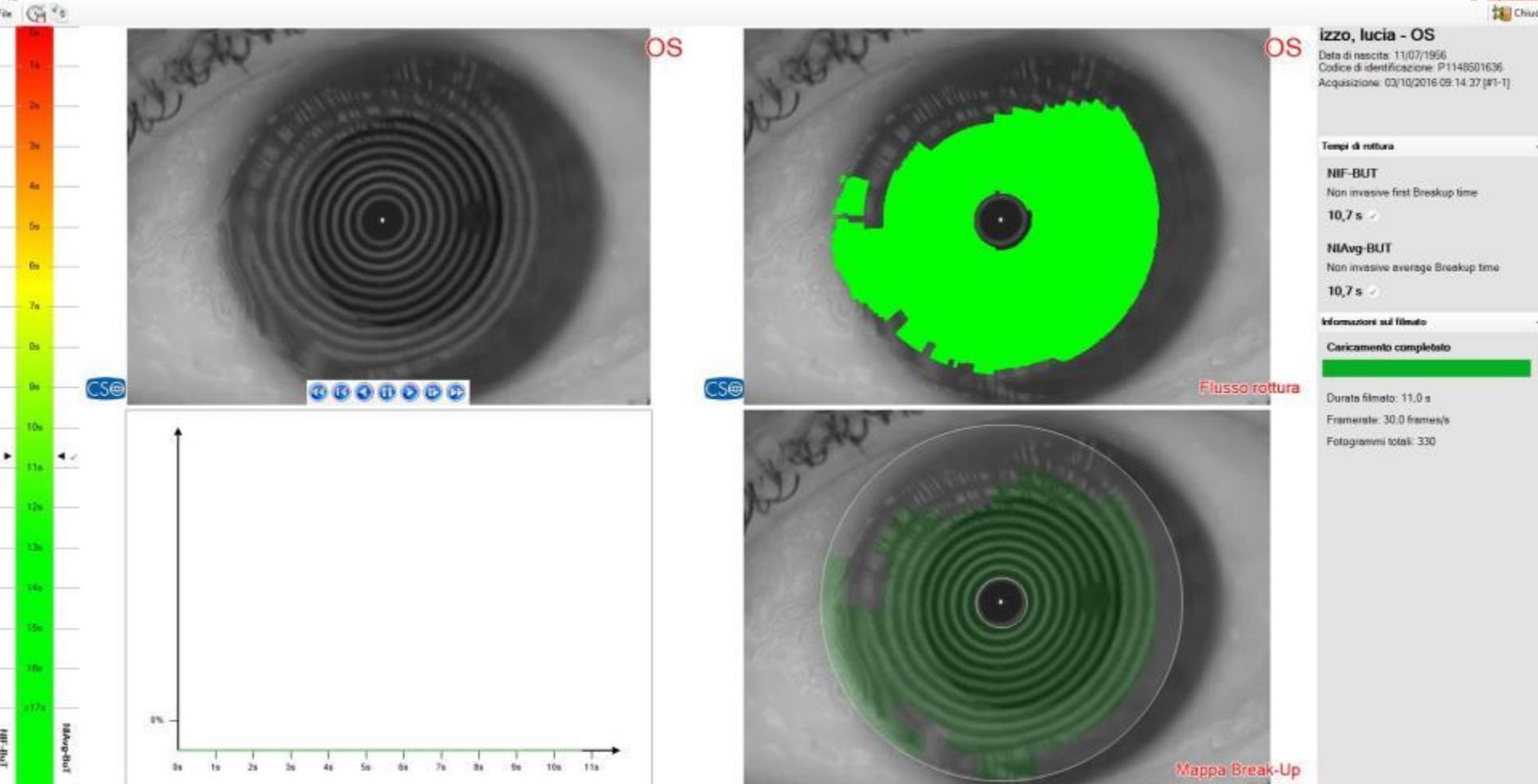
Indice di Somario

Horizontal Visible Iris Diameter
 [HVID] = 12.44 mm
↑ Pupilla (Itopografica)
 r = 0.22 mm @ 17°
 Ø = 3.52 mm
 intercetta A: r = 0.57 mm @ 17°
⊕ Punto più sottile
 r = 0.40 mm @ 177°
 Thk = 565 µm
⊖ Apice
 r = 0.60 mm @ 81°
 Thk = 570 µm Curv = 45.3
Camera anteriore
 CCT = AD r 0.565 + 3.37 - 3.94
 Volume = 185 mm³
 Angolo indo-corneale = 49°
 HA CD = 12.35 mm
 Sollevamento cristallino = -0.29 mm
Volume corneale (C) = 10 mm³
IOP

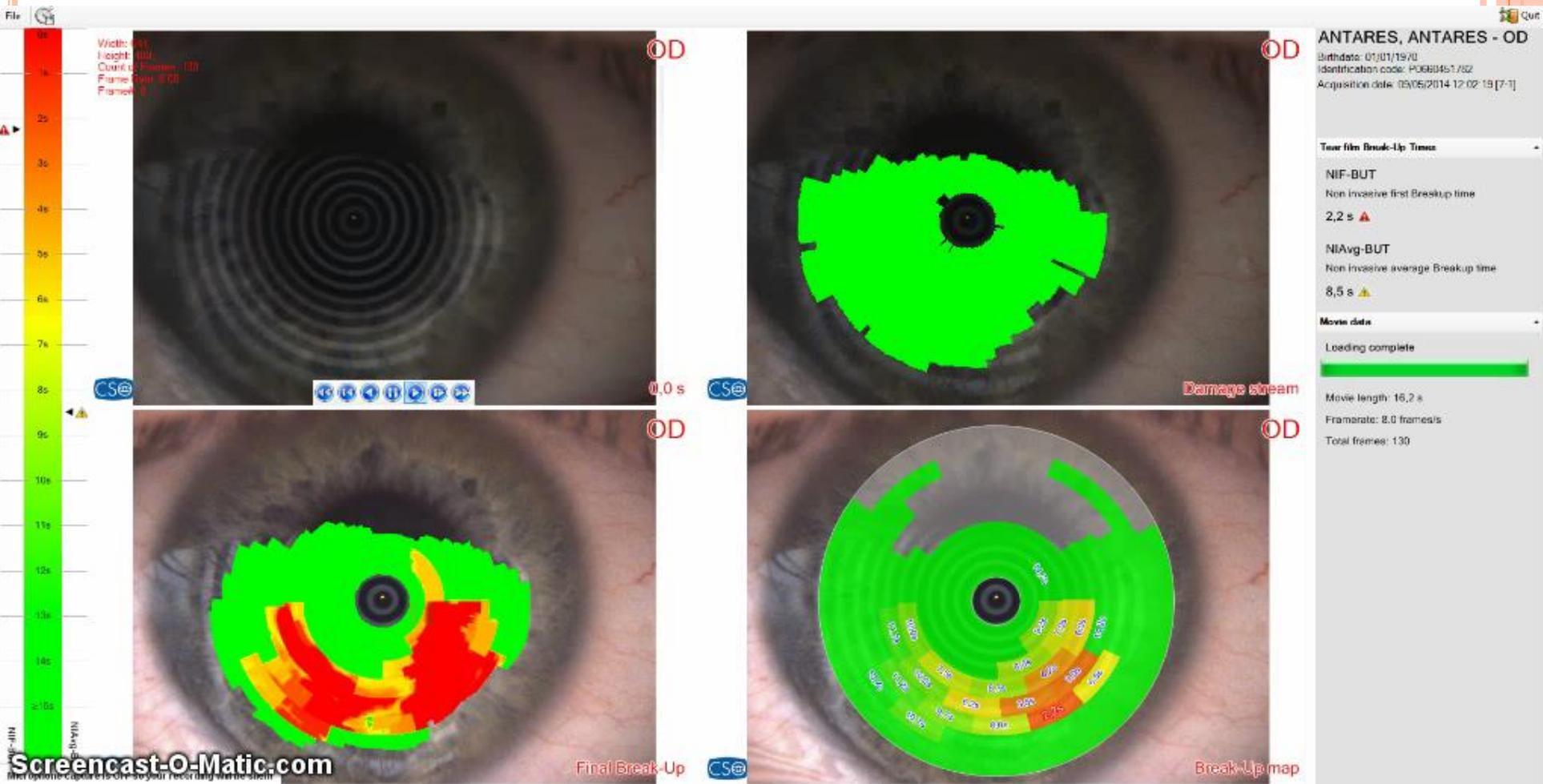
IOP [mmHg] = 16.00
 CCT = 565 µm
 ICCD = 45.67 D
 Formula di correzione della IOP:
 Ehlers
 Δ IOP = -1.43 mmHg
 IOP corretta = 14.57 mmHg



Analisi del film lacrimale



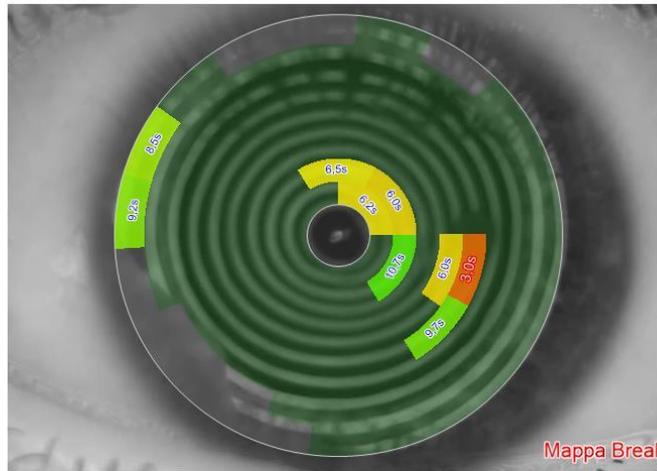
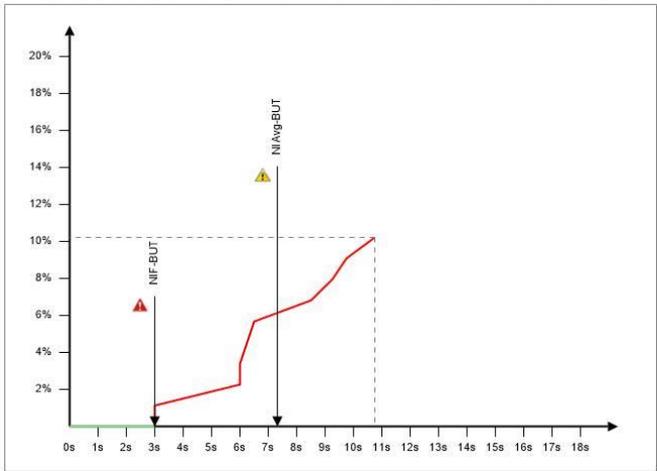
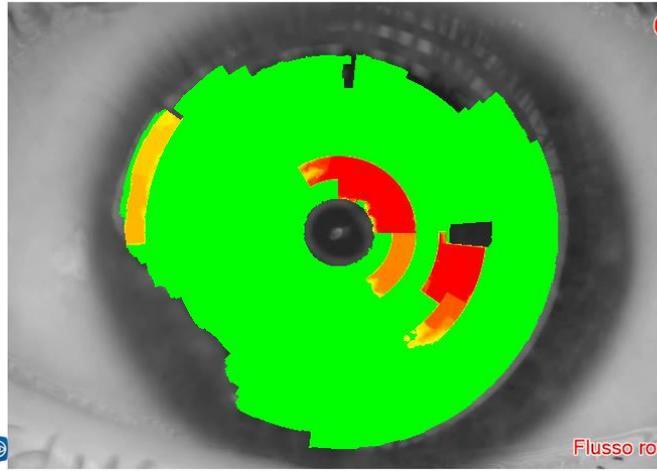
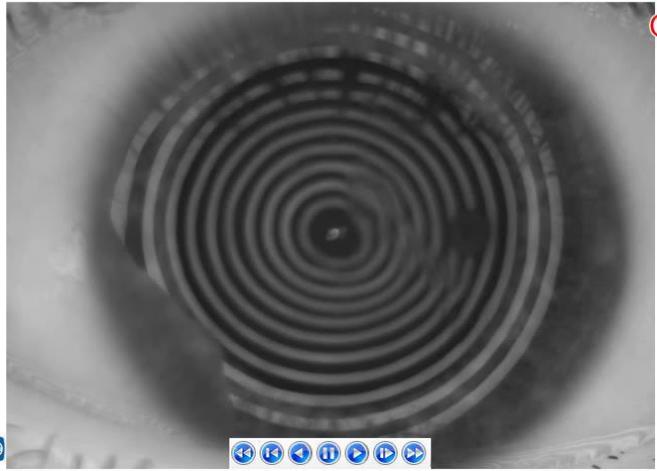
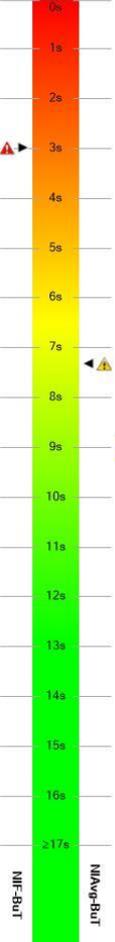
Analisi del film lacrimale



FILM LACRIMALE

File

Chiudi



braccini, eleonora - OS

Data di nascita: 26/10/1978
Codice di identificazione: P0872077201
Acquisizione: 14/09/2016 09:26:05 [#1-1]

Tempi di rottura

NIF-BUT
Non invasive first Breakup time
3,0 s ▲

NIAvg-BUT
Non invasive average Breakup time
7,3 s ▲

Informazioni sul filmato

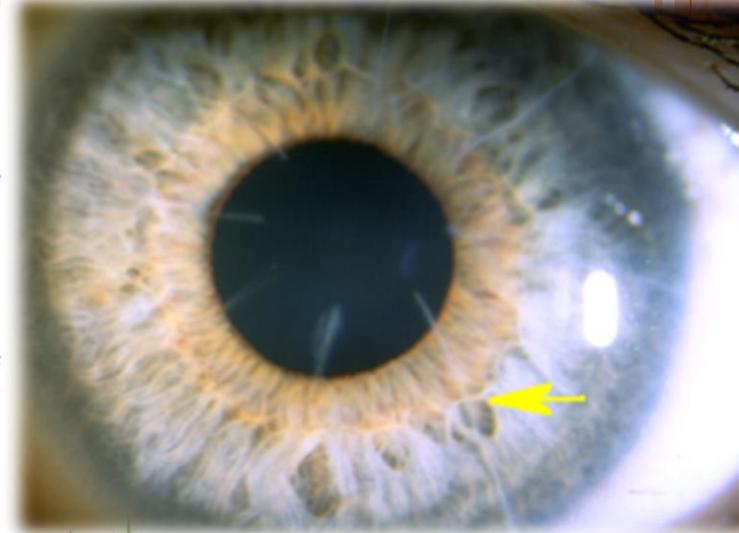
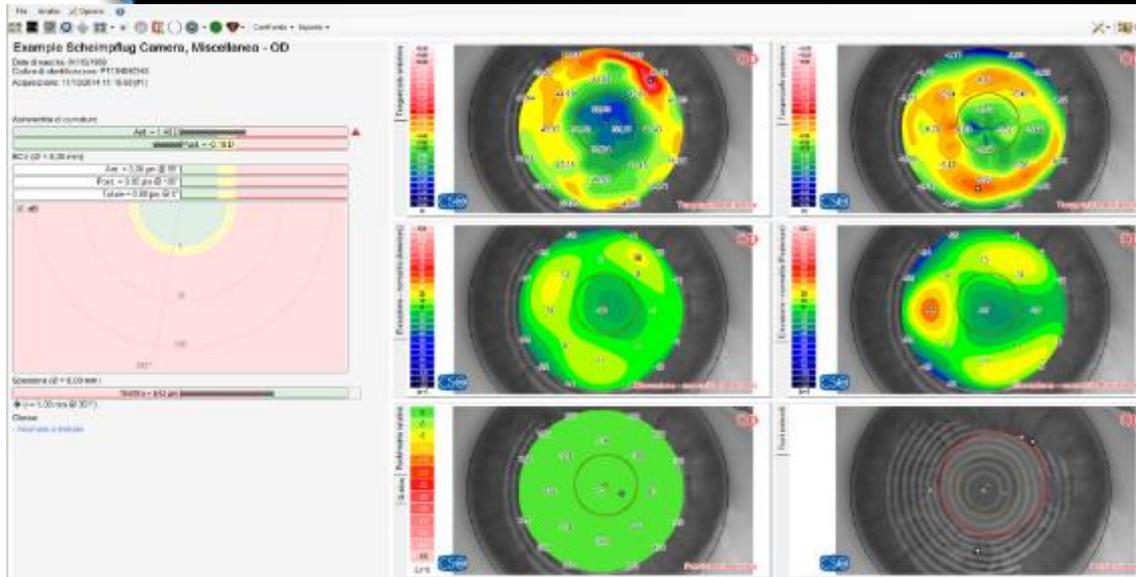
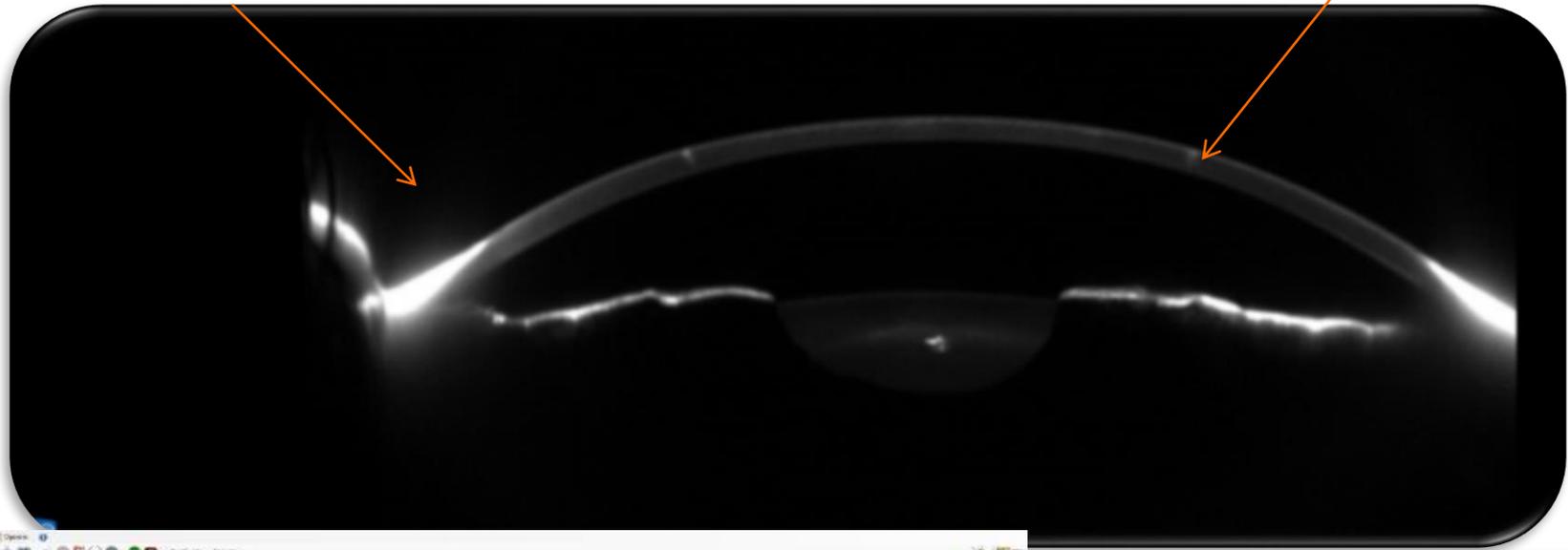
Caricamento completato



Durata filmato: 17,6 s
Framerate: 28,0 frames/s
Fotogrammi totali: 494



Post OP PRK



OCT segmento anteriore

Utilizza il principio dell'*interferometria a coerenza ottica*
Il ritardo e l'intensità della luce riflessa dalle strutture analizzate viene confrontata con quella riflessa da uno specchio di riferimento

SA Lunghezza d'onda di 1310 nm

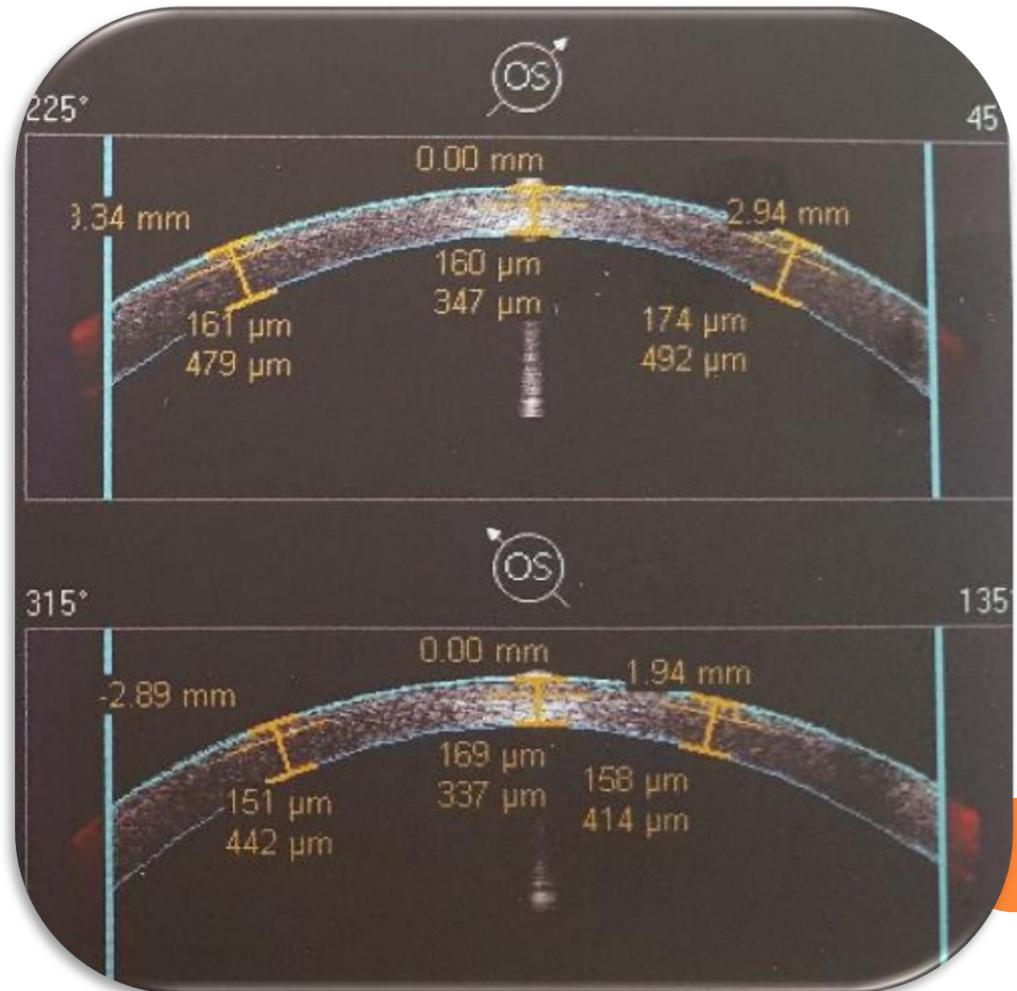
UTILIZZI

- Precisa pachimetria
- Analisi dell'angolo iridocorneale
- Follow-up postoperatorio
Post cheratoplastica
DALK
DSAEK
- Precisa misurazione residuo stromale e visualizzazione del flap dopo LASIK
- Dimensioni della camera anteriore prima impianto di IOL facheiche
- Follow-up postoperatorio della posizione effettiva dell'impianto
- Analisi dell'architettura dell'incisione corneale chirurgia cataratta
- Relazioni spaziali tra la IOL e la capsula posteriore
- Monitoraggio della bozza filtrante
- Analisi e valutazione di tumori del segmento anteriore e della congiuntiva



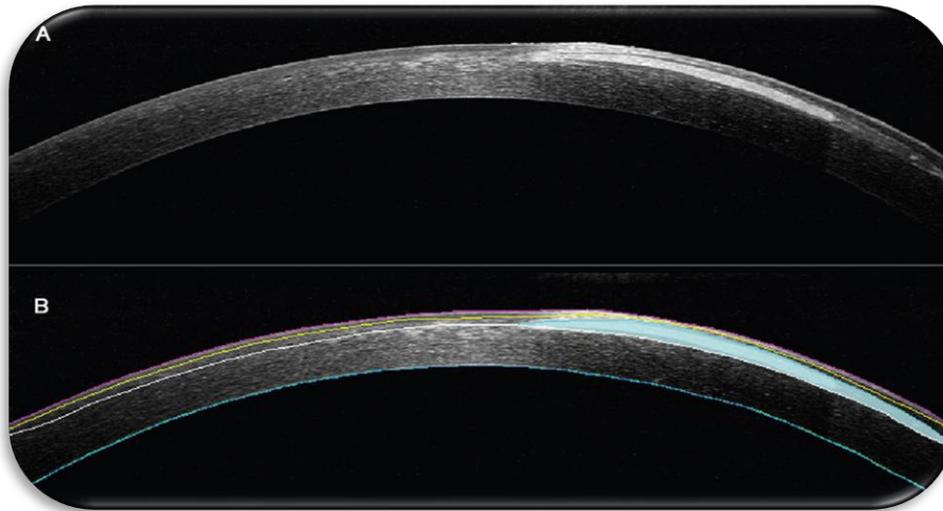
UTILIZZI

- Precisa pachimetria



UTILIZZI

- Nella chirurgia refrattiva follow-up postoperatorio

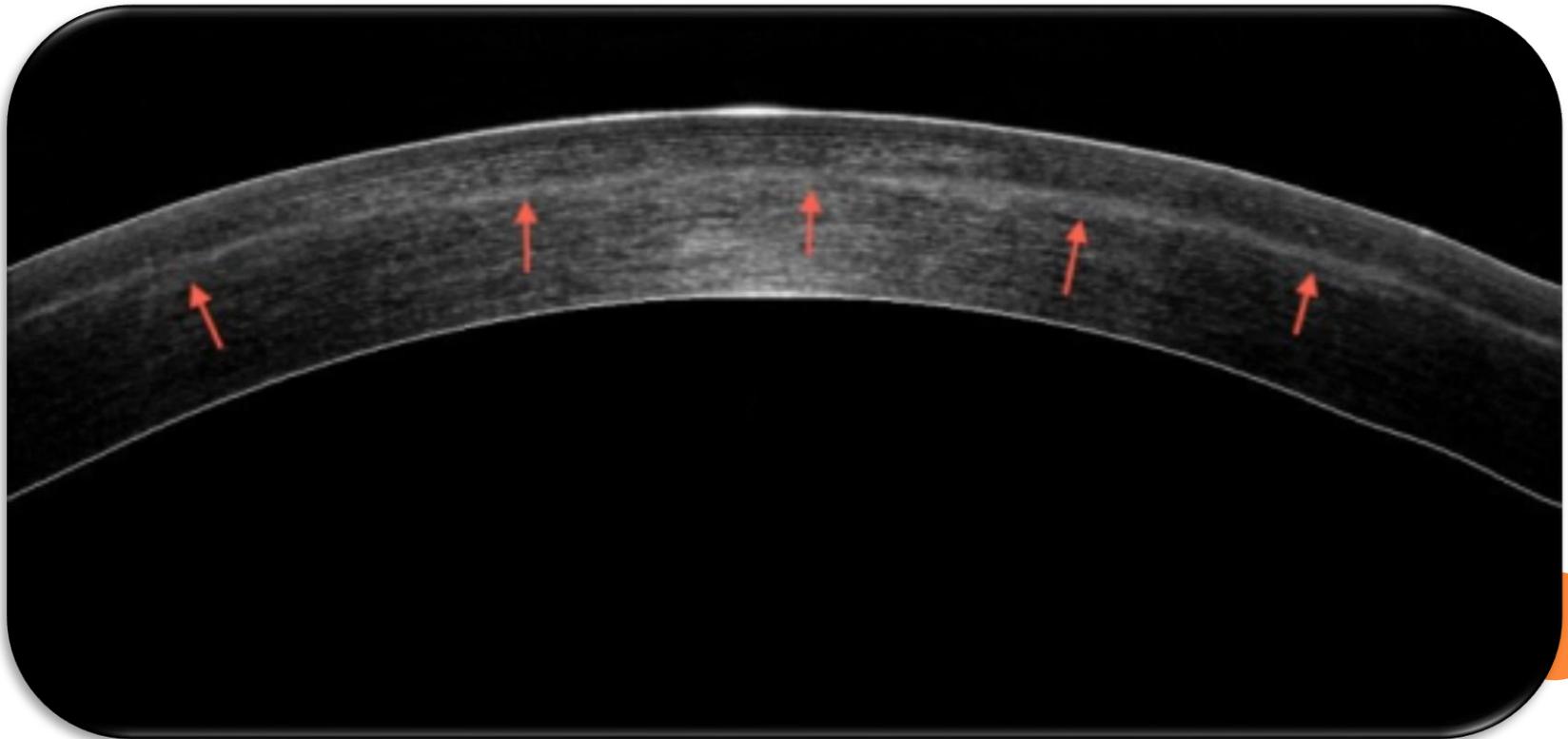


Epithelial ingrowth
POST LASIK,



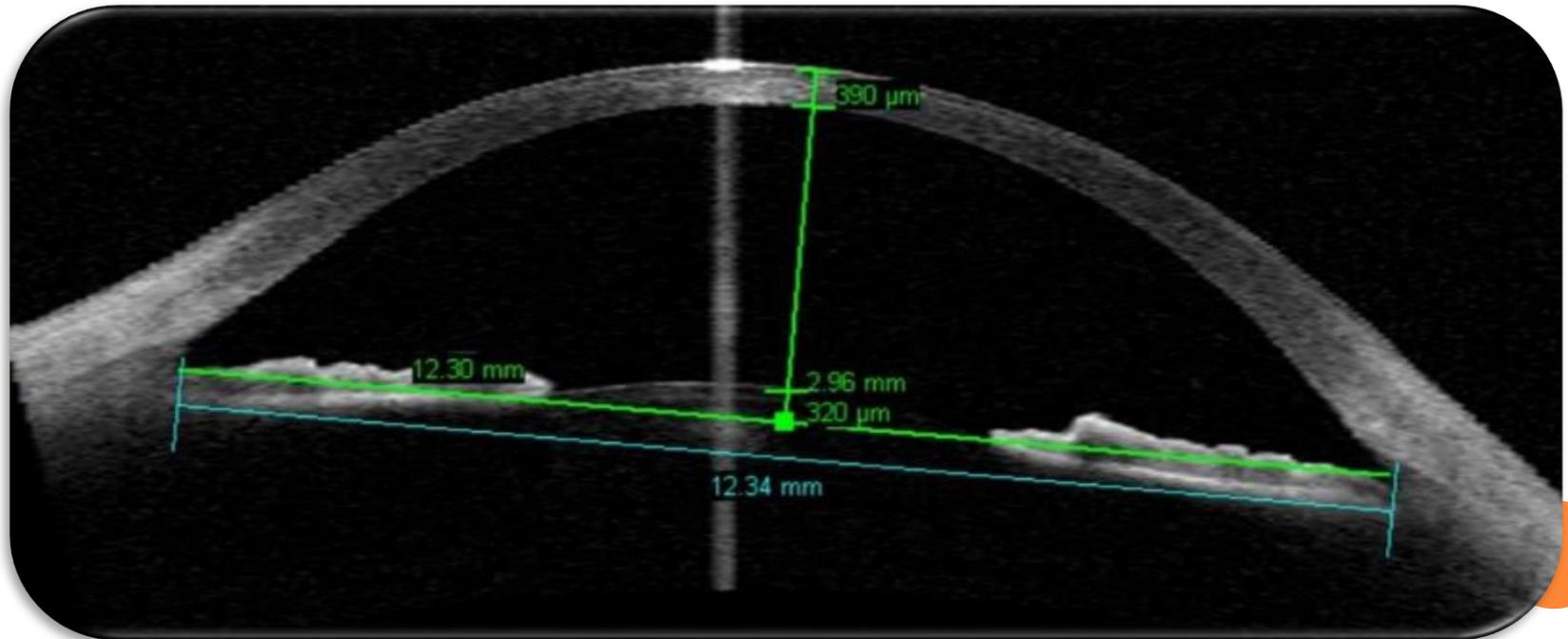
UTILIZZI

- Precisa misurazione del residuo stromale e visualizzazione del flap dopo LASIK

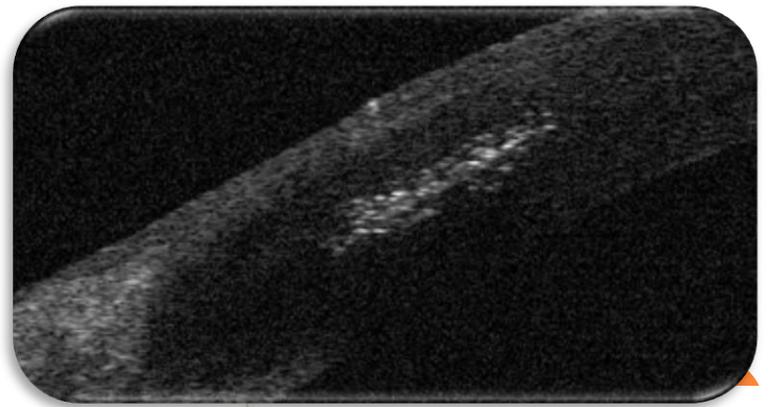
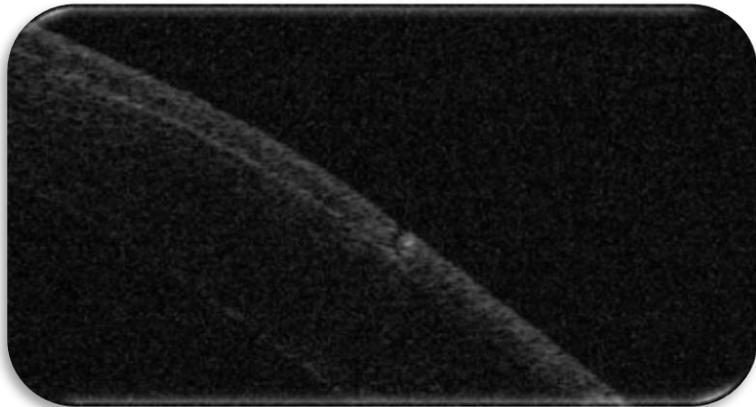
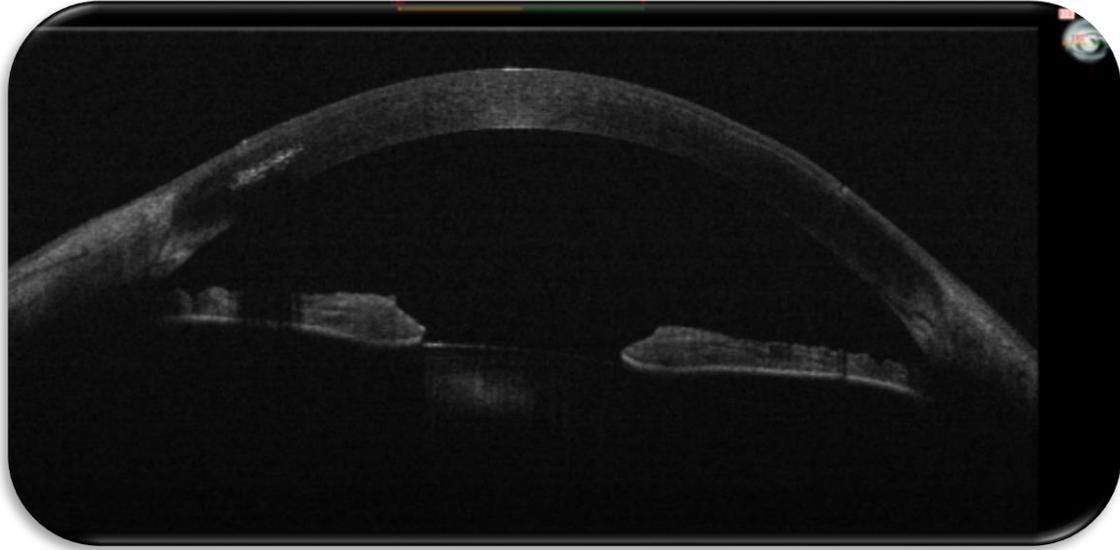


UTILIZZI

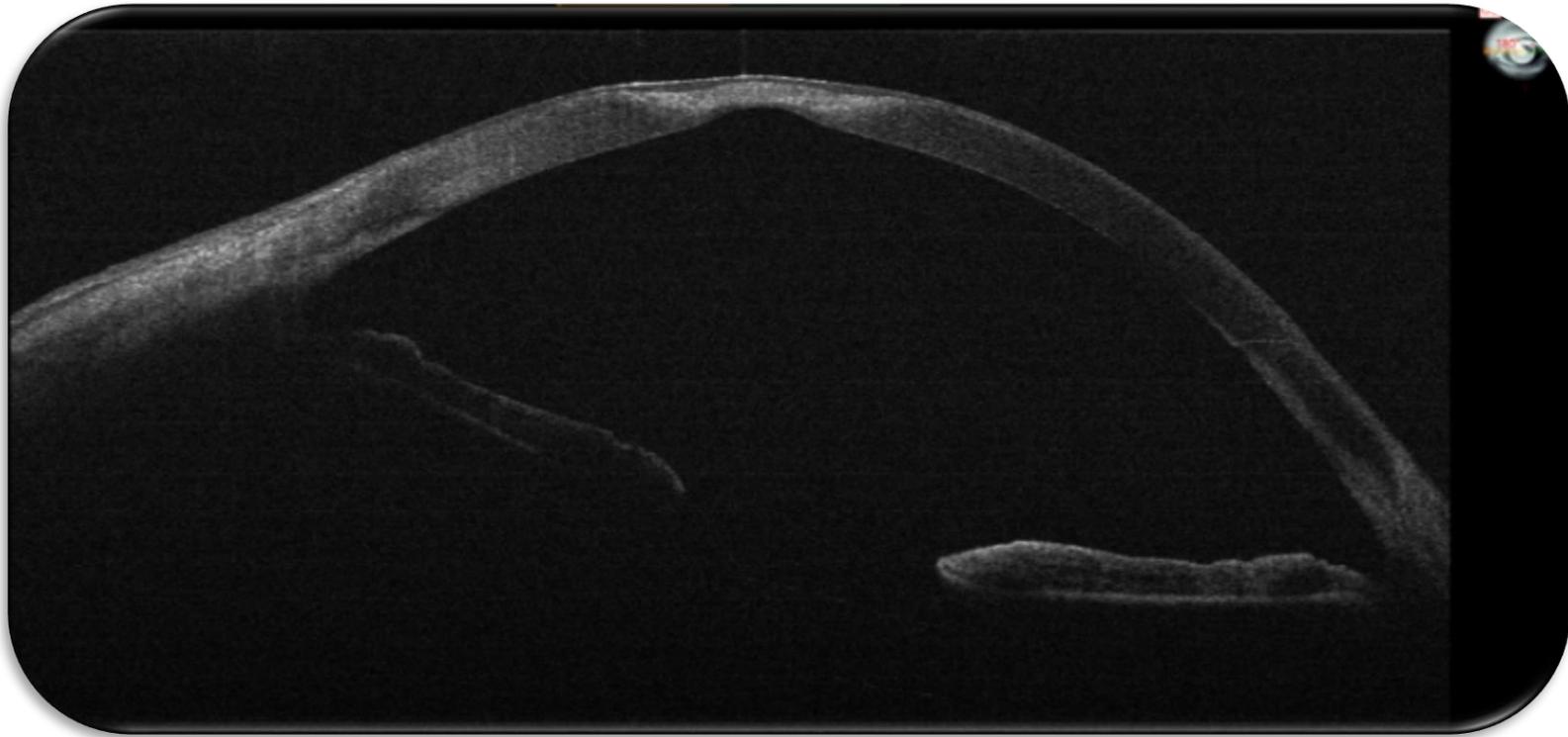
- Valtazione delle dimensioni della camera anteriore prima dell'impianto di IOL facheiche



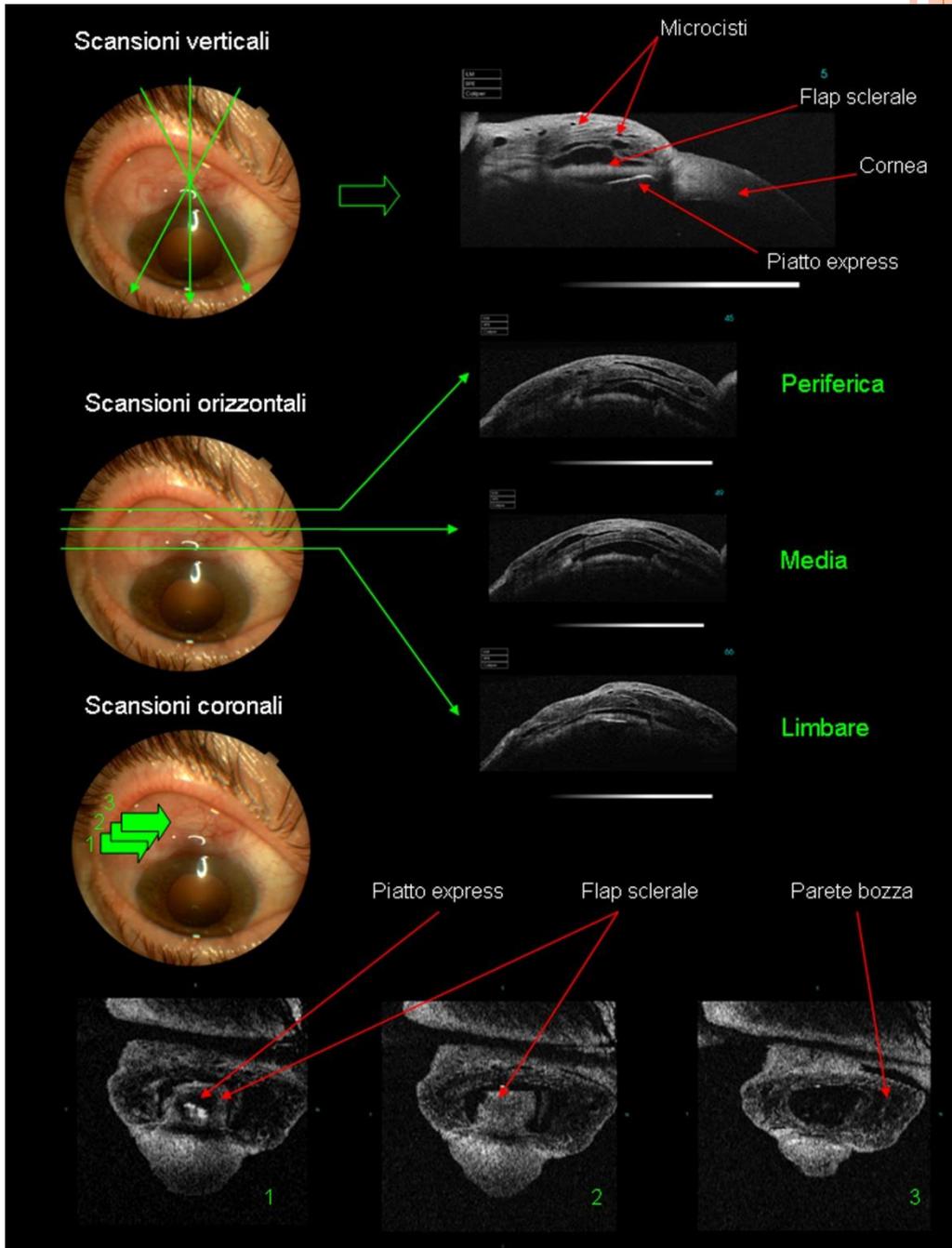
LASIK OCT



Ulcera oct

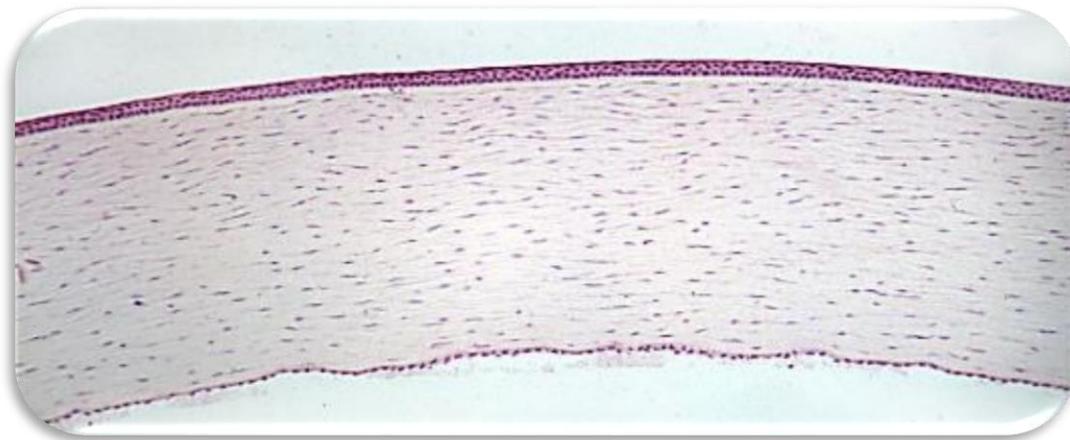


VISUALIZZAZIONE DEGLI IMPIANTI DI DRENAGGIO E DELLA LORO POSIZIONE



MICROSCOPIA CONFOCALE

STUDIO ISTOLOGICO IN VIVO



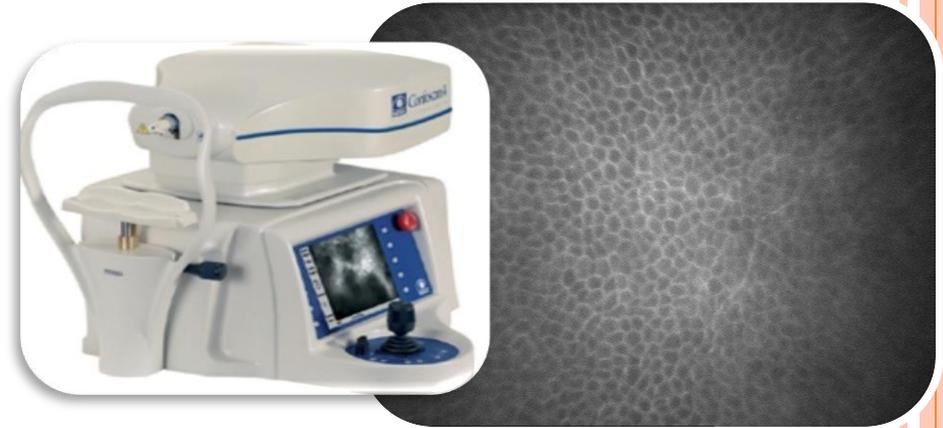
Non standardizzabile
Operatore dipendente
Compliance del paziente



MICROSCOPI CONFOCALI

- **ConfoScan 4.0**

Luce bianca White Light Source
(Nidek Technologies, Italy)



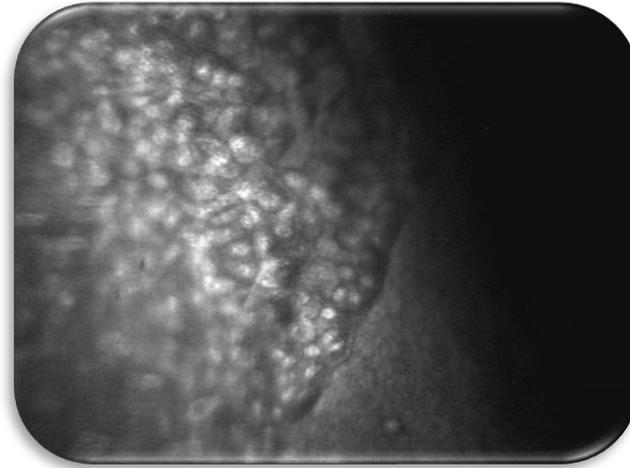
- **HRT 3**

Laser
(Heidelberg Eng., Germany)



PATOLOGIE CORNEALI

Estensione
Localizzazione
Profondità

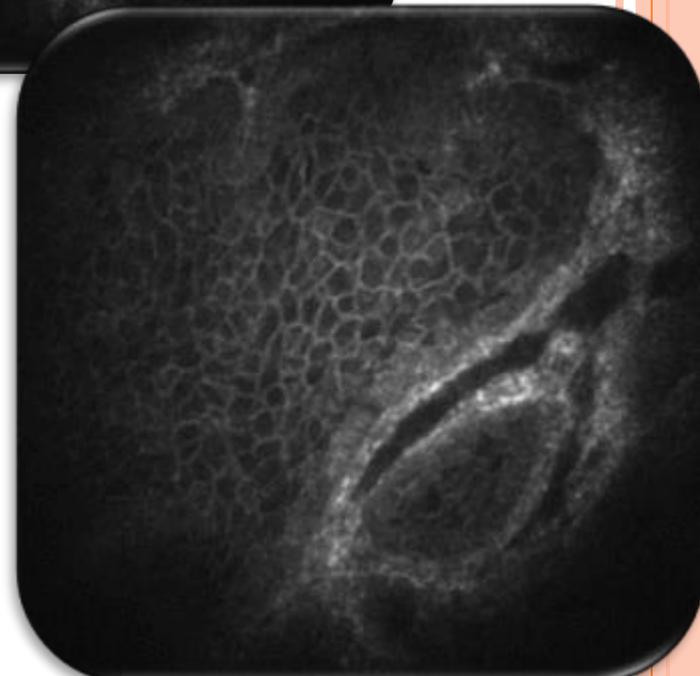
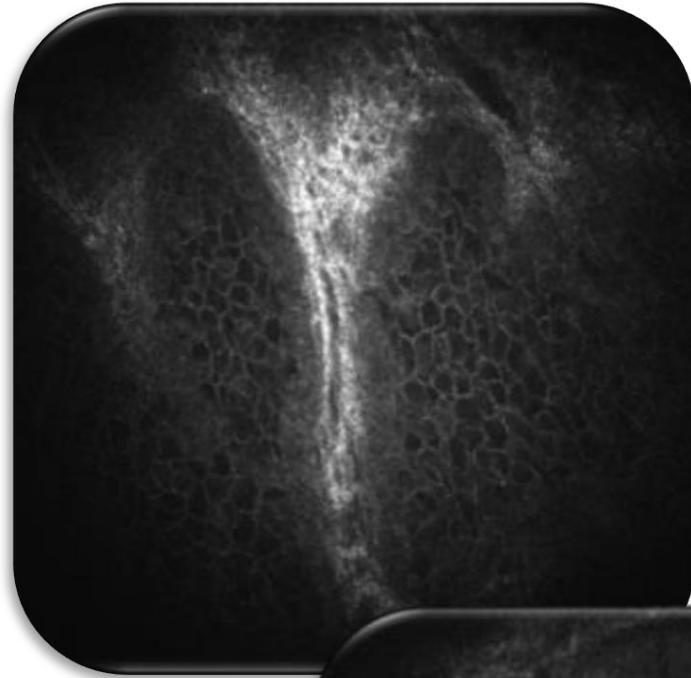


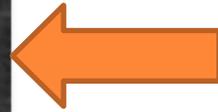
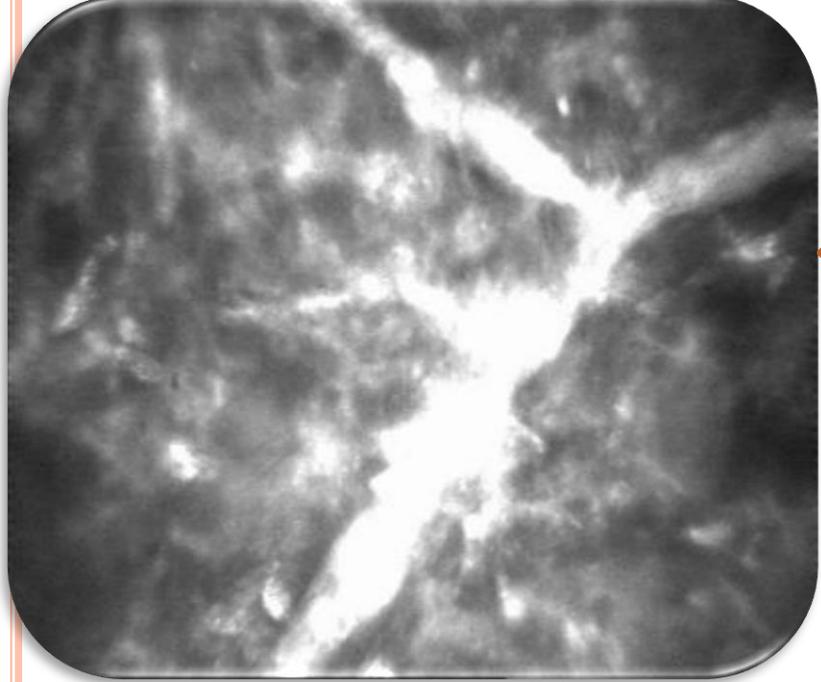
Diagnosi patologie corneali
Ausilio approccio chirurgico
Follow-up chirurgico



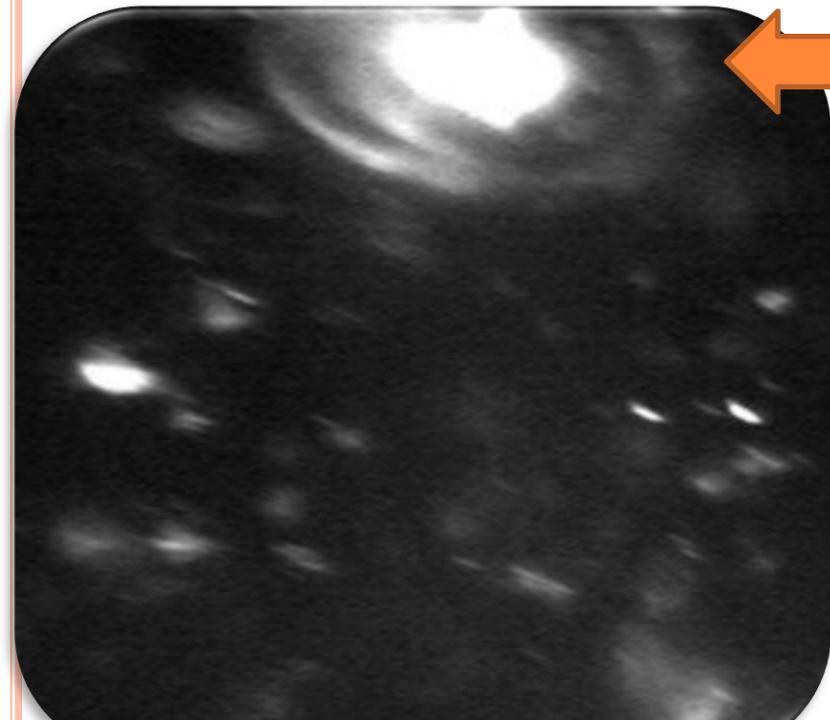
Limbus sclero-corneale

- Epitelio corneale pluristratificato
- Epitelio congiuntivale monostratificato
- Epitelio di transizione con caratteristiche e riflettività intermedie
- Le cellule sono più piccole e hanno maggiore densità
- Palizzate di Vogt: invaginazioni del piano epiteliale che si ripiega radialmente rispetto alla cornea





Ife fungine

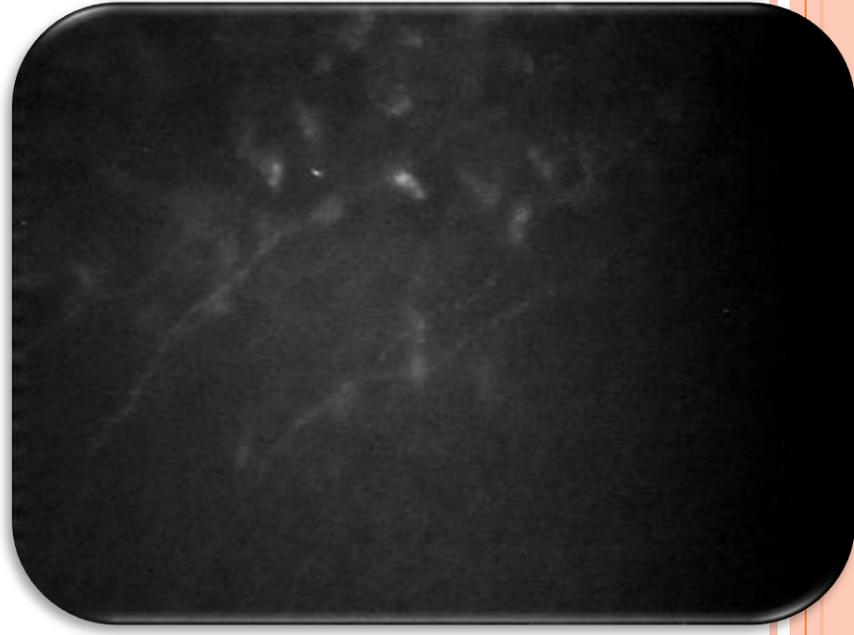
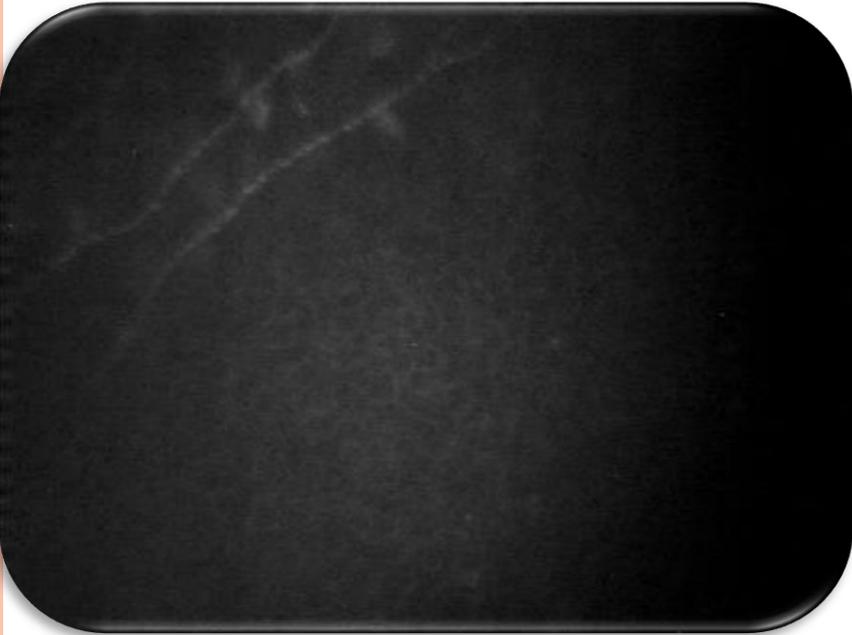
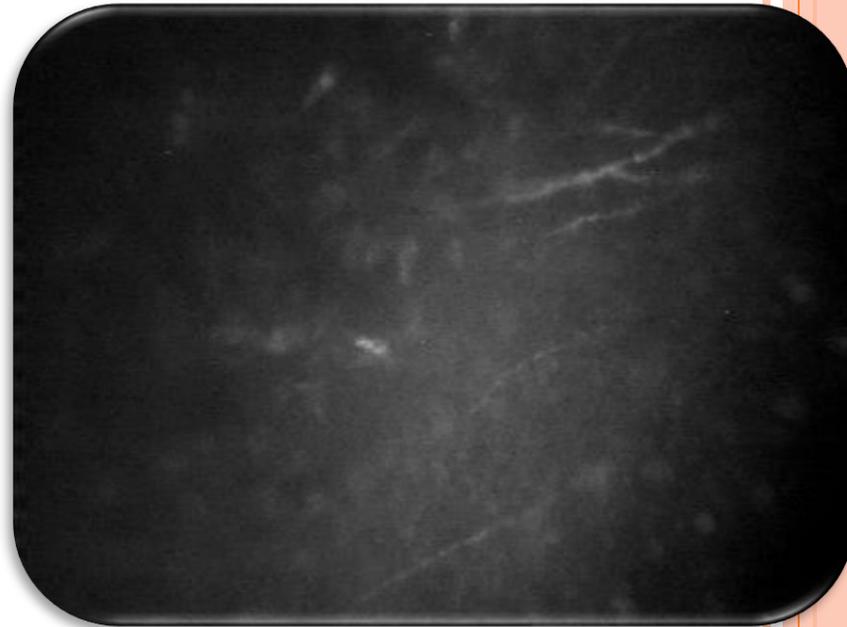
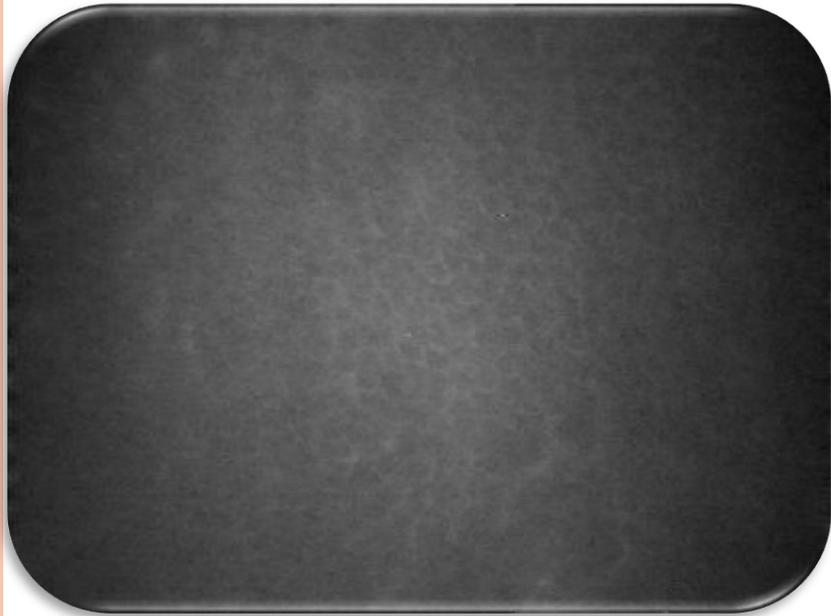


Acanthamoeba (cisti con doppia parete)



CHERATOPLASTICA PERFORANTE

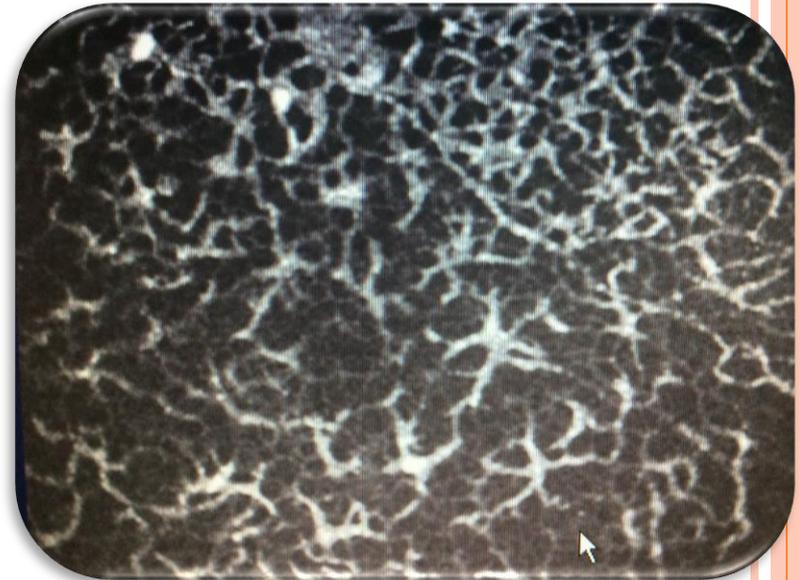
Studio reinnervazione corneale



VALUTAZIONE RIGETTO

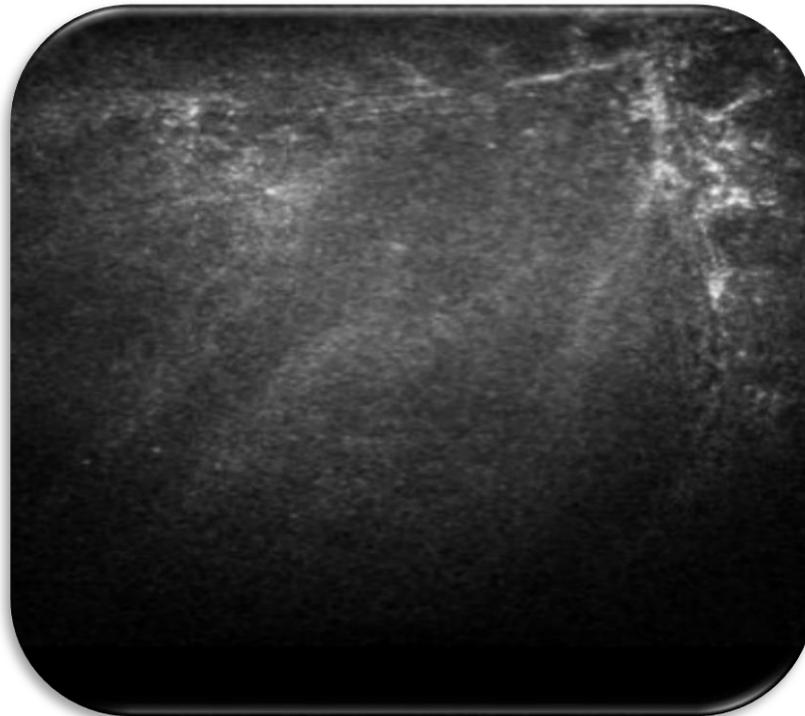
Rigetto epiteliale

- Rigetto endoteliale : popolazione linfocitaria che invade la superficie endoteliale e lo stroma

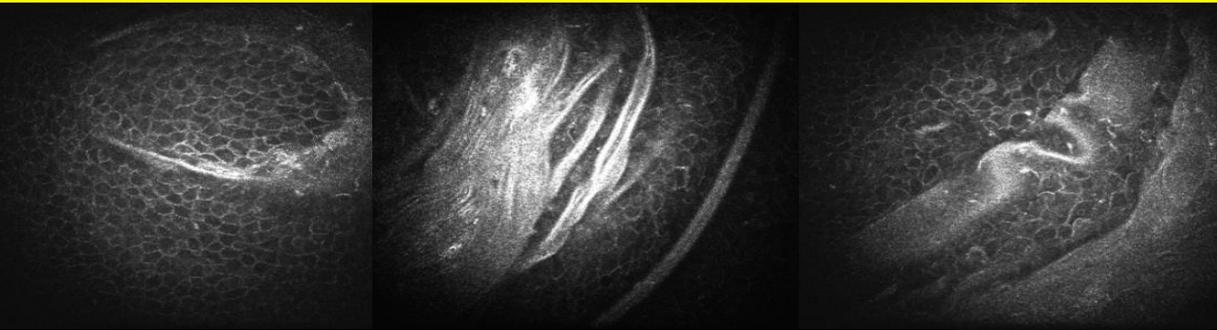
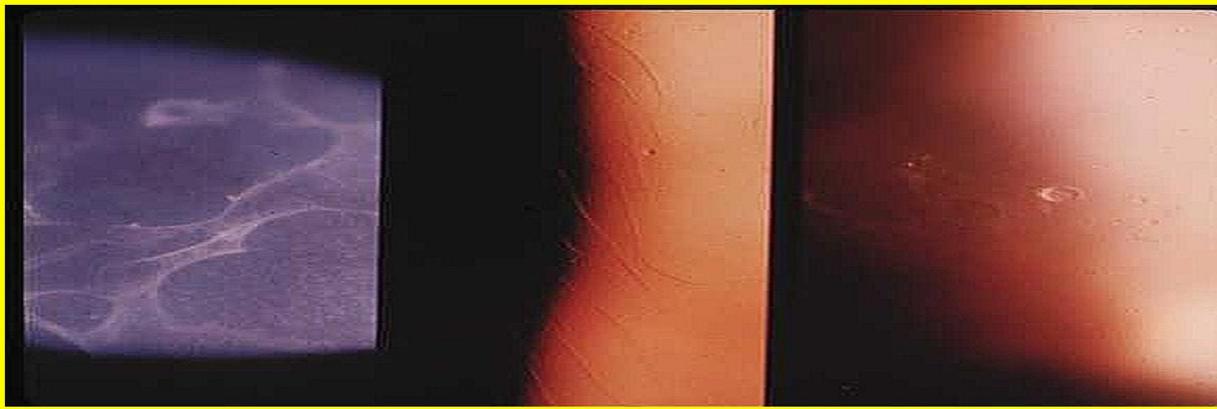


CHERATOPLASTICA LAMELLARE:

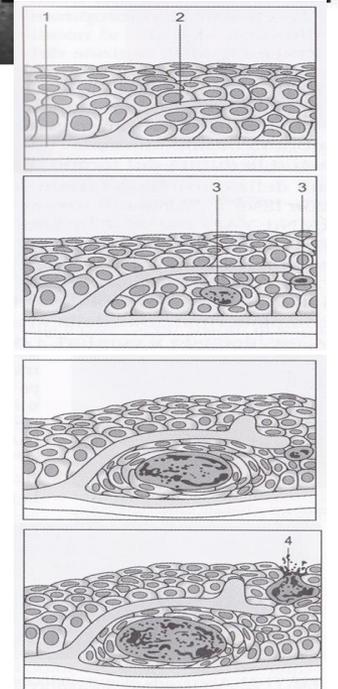
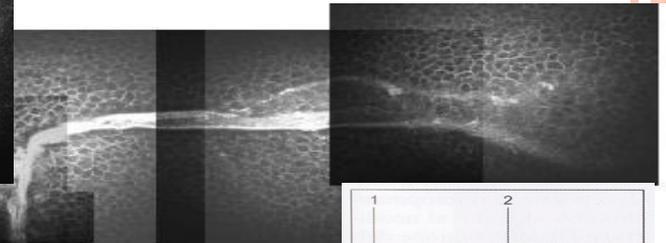
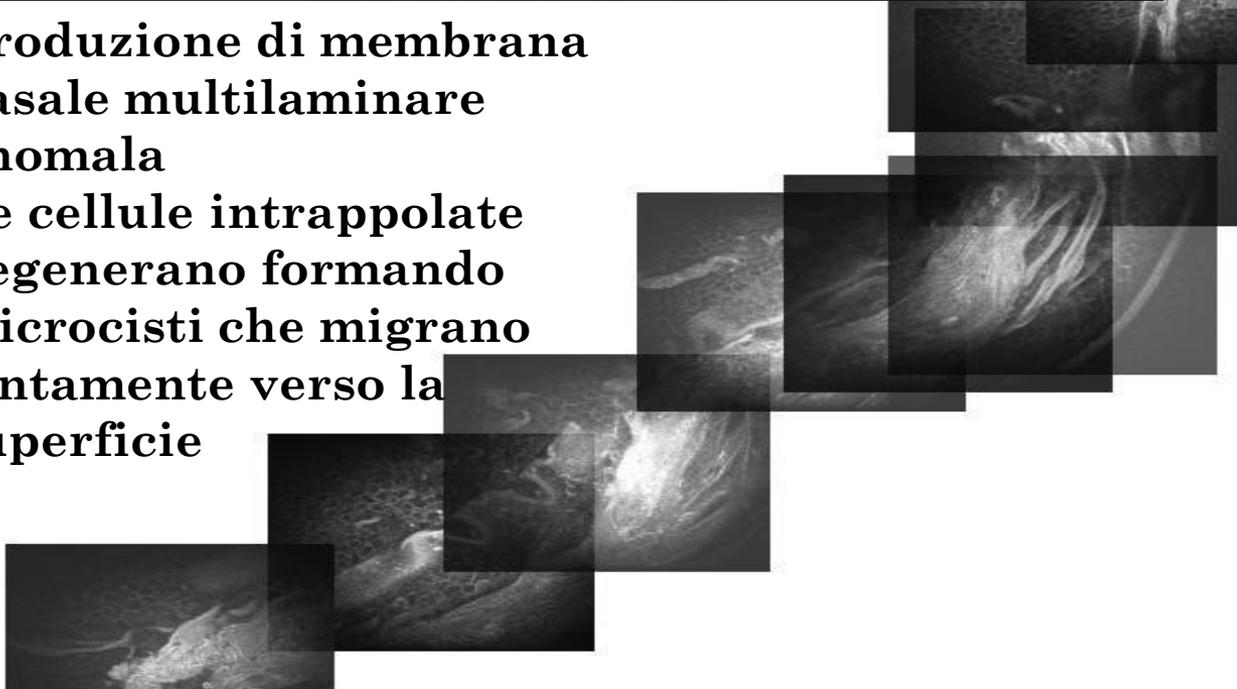
- Visualizzazione diretta dell'interfaccia stromale



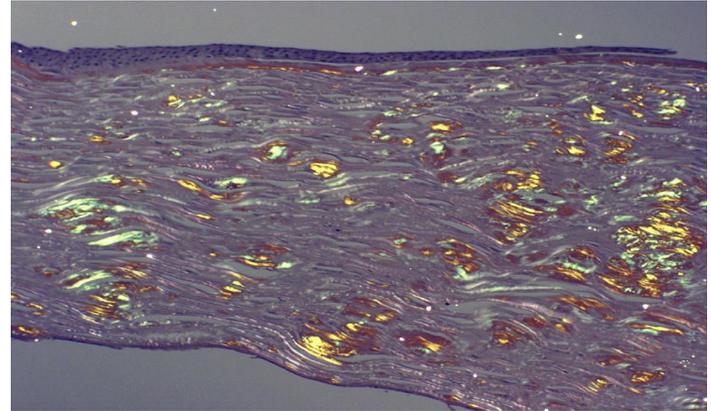
Epithelial basement membrane dystrophy (EBMD)



Produzione di membrana basale multilaminare anomala
Le cellule intrappolate degenerano formando microcisti che migrano lentamente verso la superficie



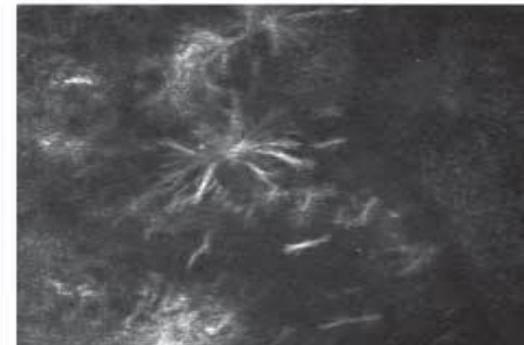
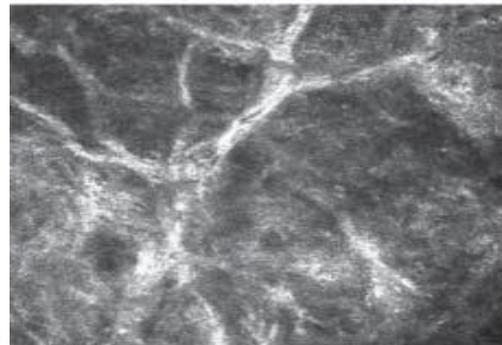
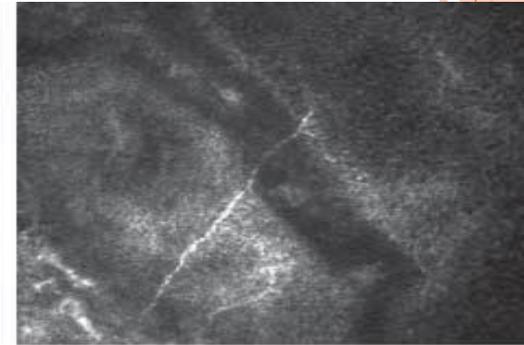
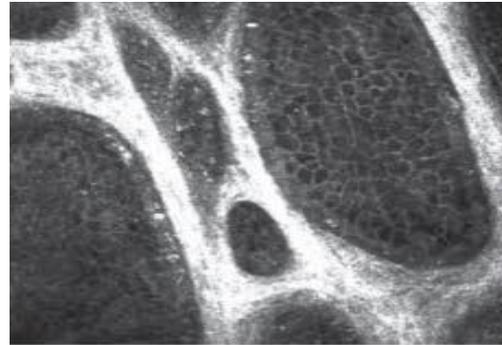
LATTICE CORNEAL DYSTROPHY (LCD1, LCD2)



Depositi di amiloide: masse formate da fini fibrille elettrondense del diametro di 8-10 nm disposte in maniera disordinata. I cheratociti circostanti appaiono degenerati con una vacuolizzazione citoplasmatica

Microscopia confocale

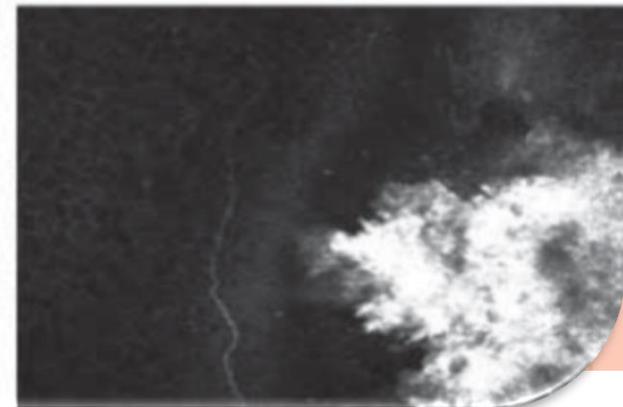
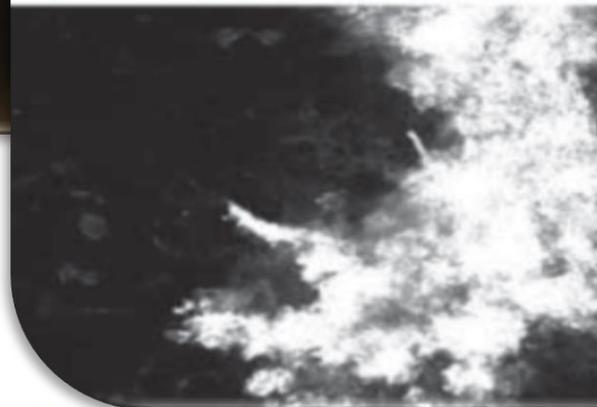
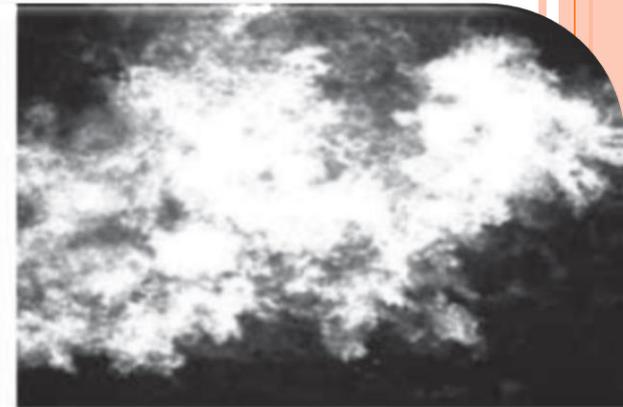
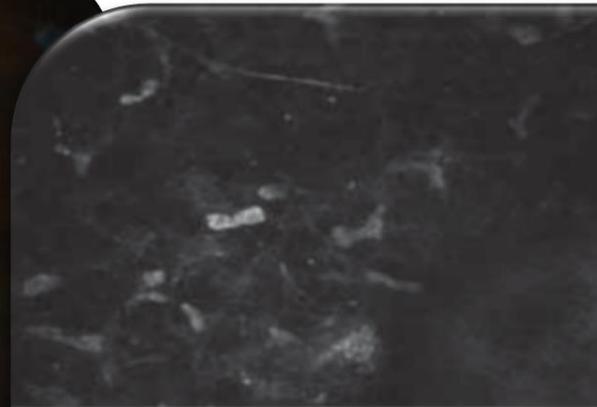
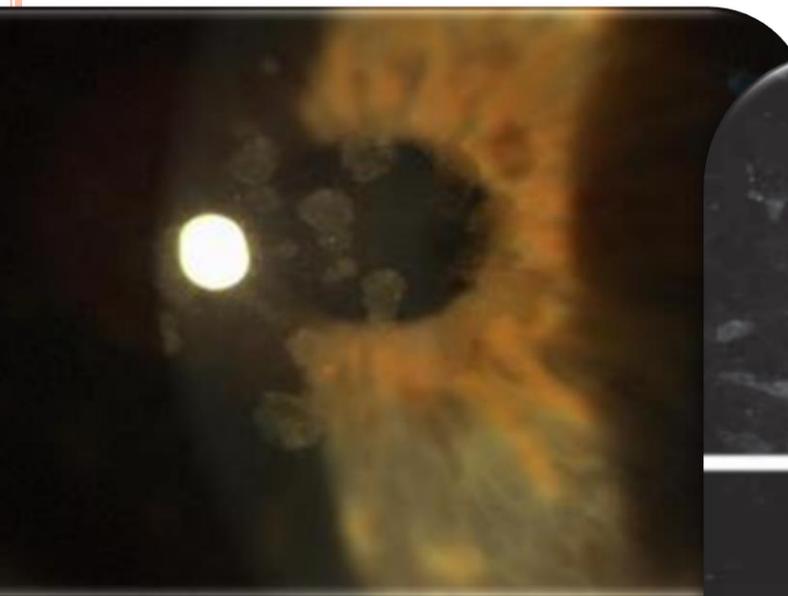
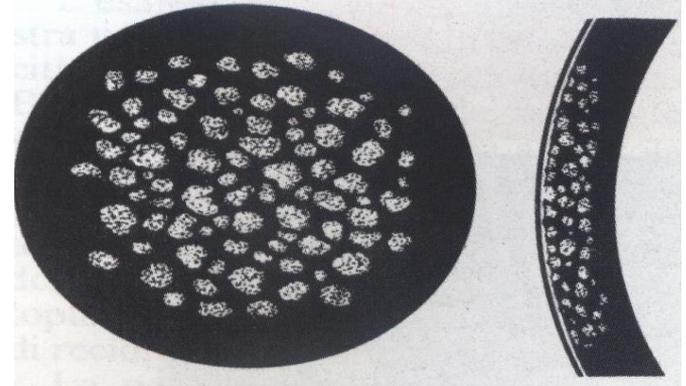
Filamenti ramificati di alta riflettività a livello dello stroma anteriore; depositi extracellulari reticolati a livello della membrana basale



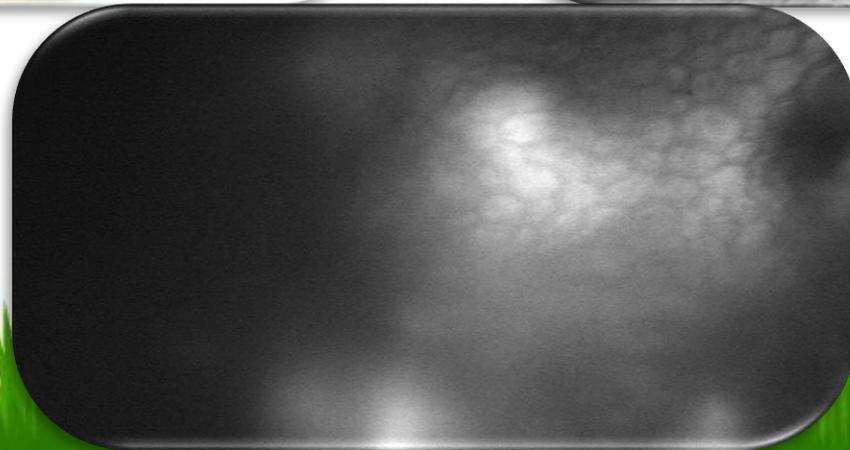
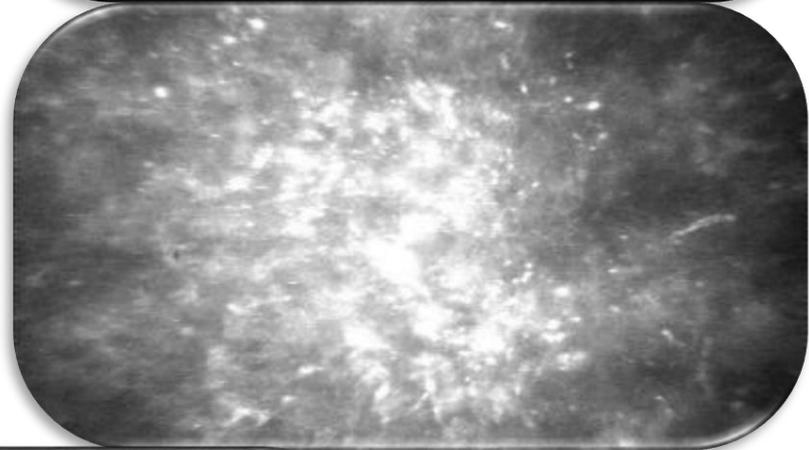
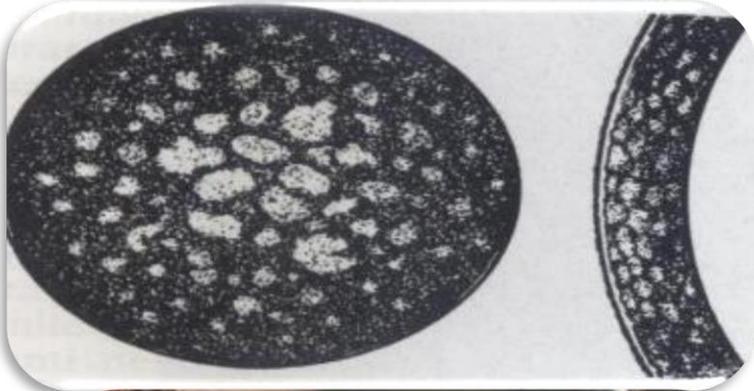
GRANULAR CORNEAL DYSTROPHY, TYPE 1 (CLASSIC) (GCD1)

Esordio circa a 2 anni, AD, 5q31. TGFBI

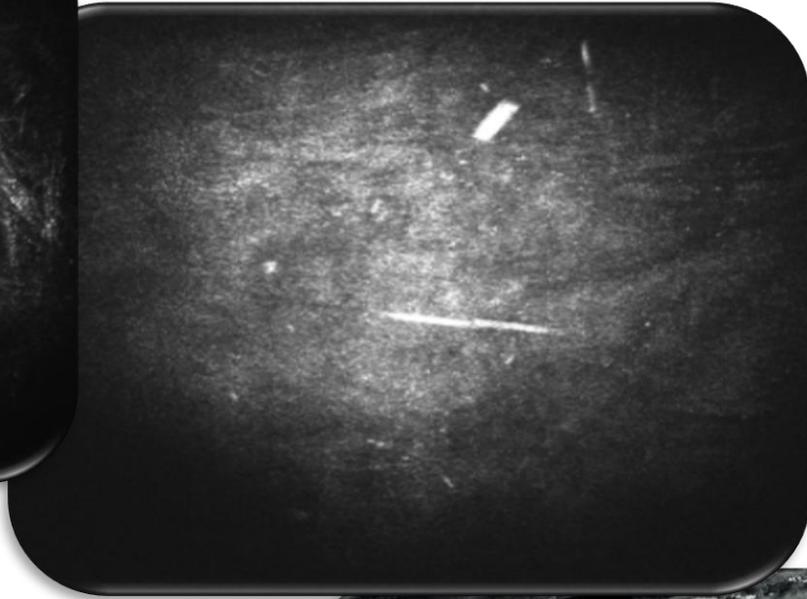
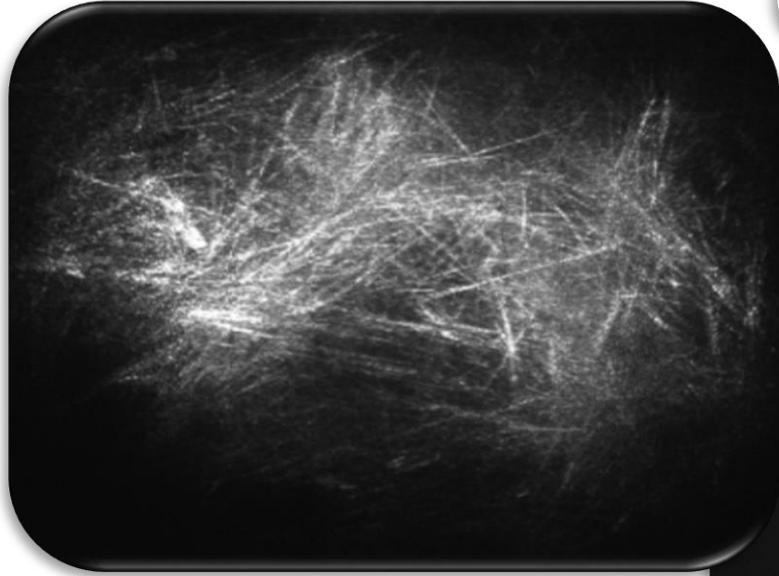
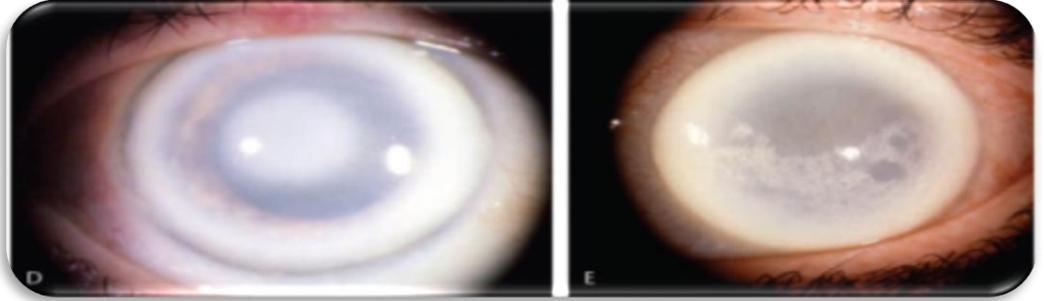
Opacità granulari biancastre



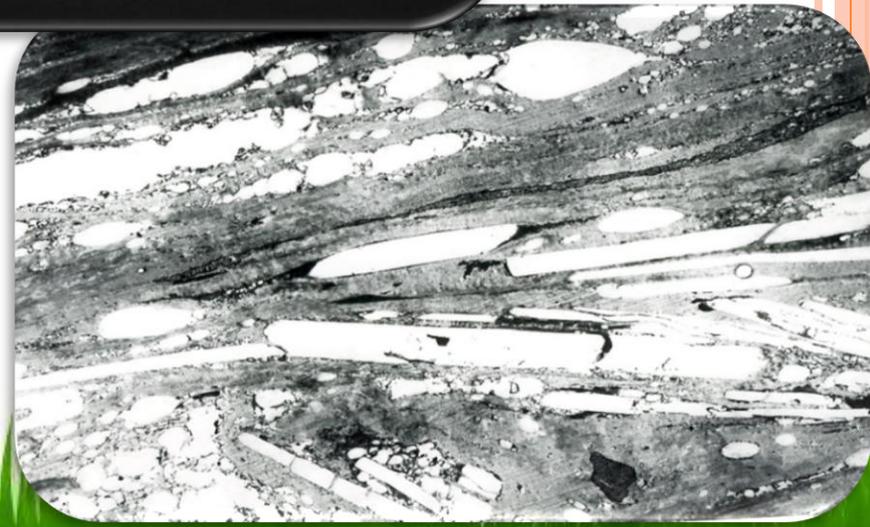
MACULAR CORNEAL DYSTROPHY (MCD)



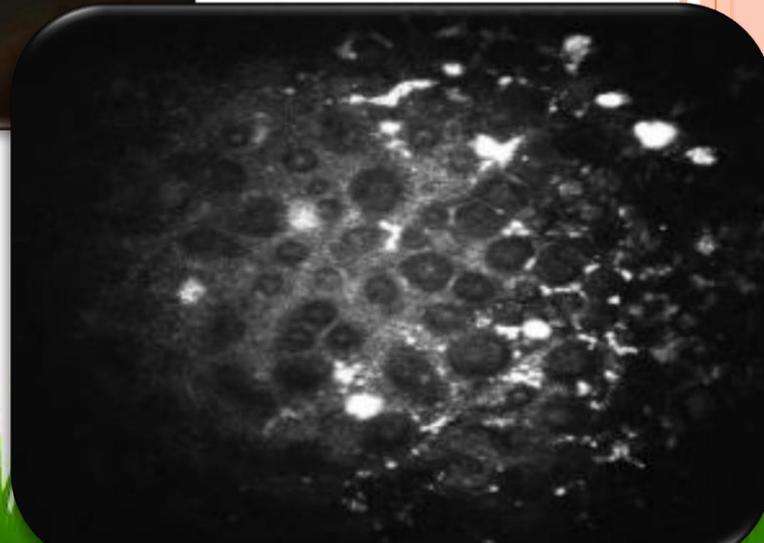
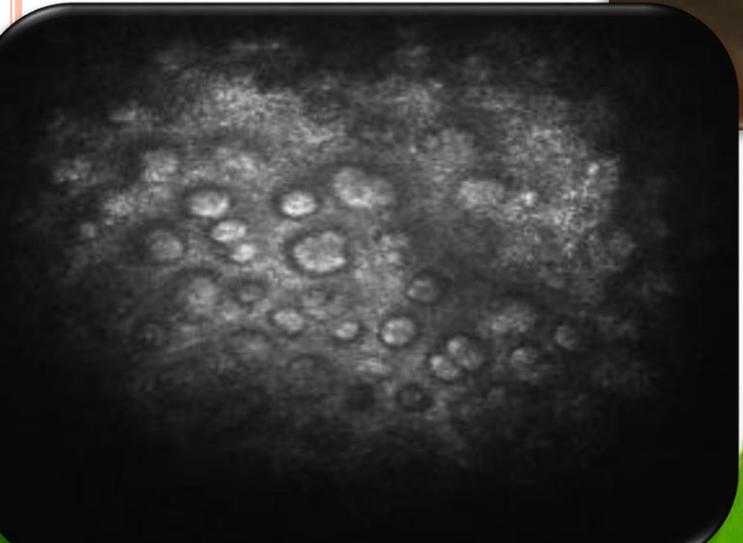
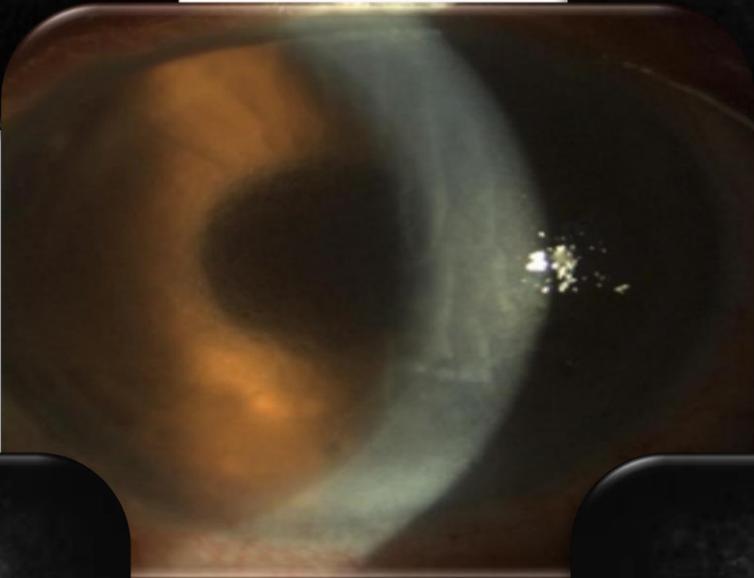
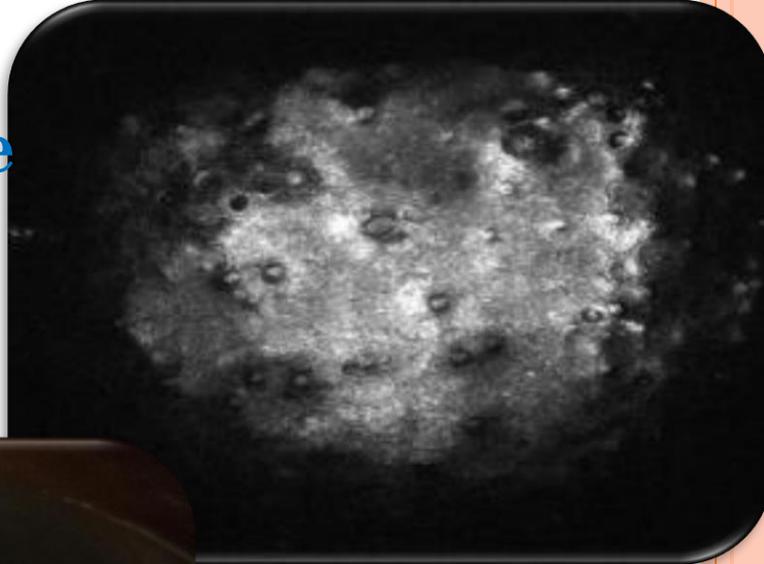
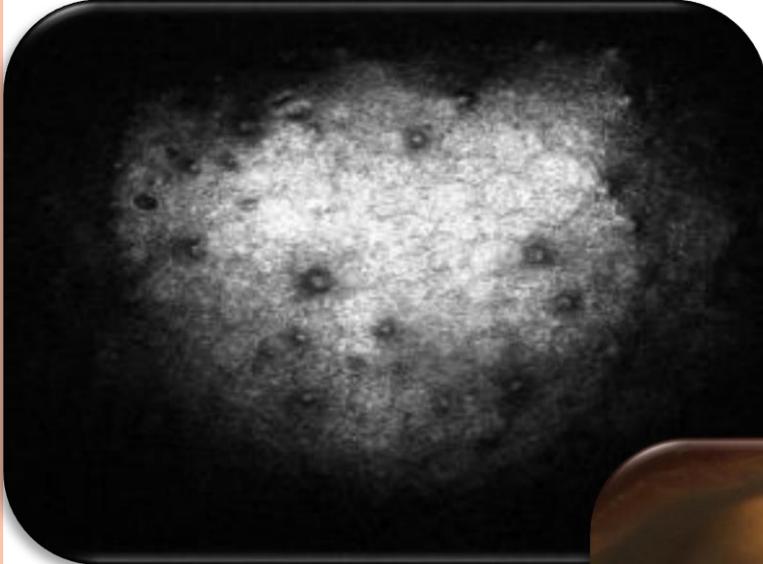
Schnyder Corneal Dystrophy (SCD) [cristallina]

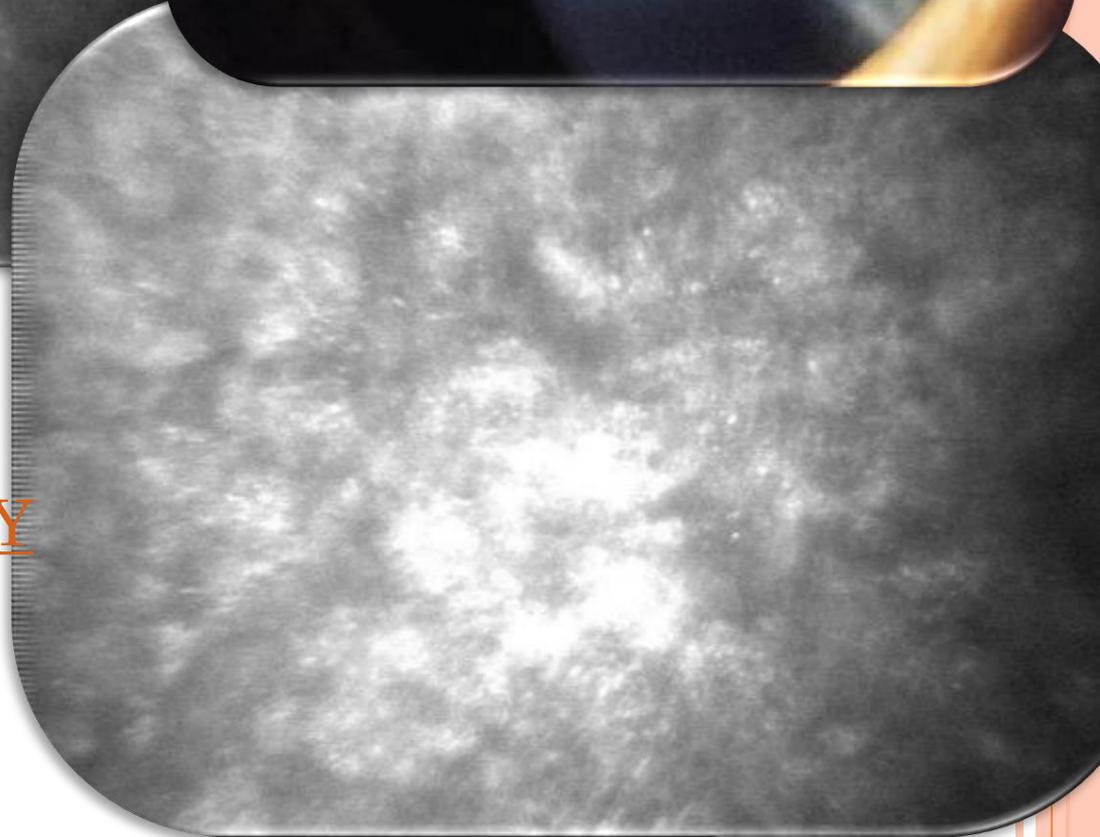
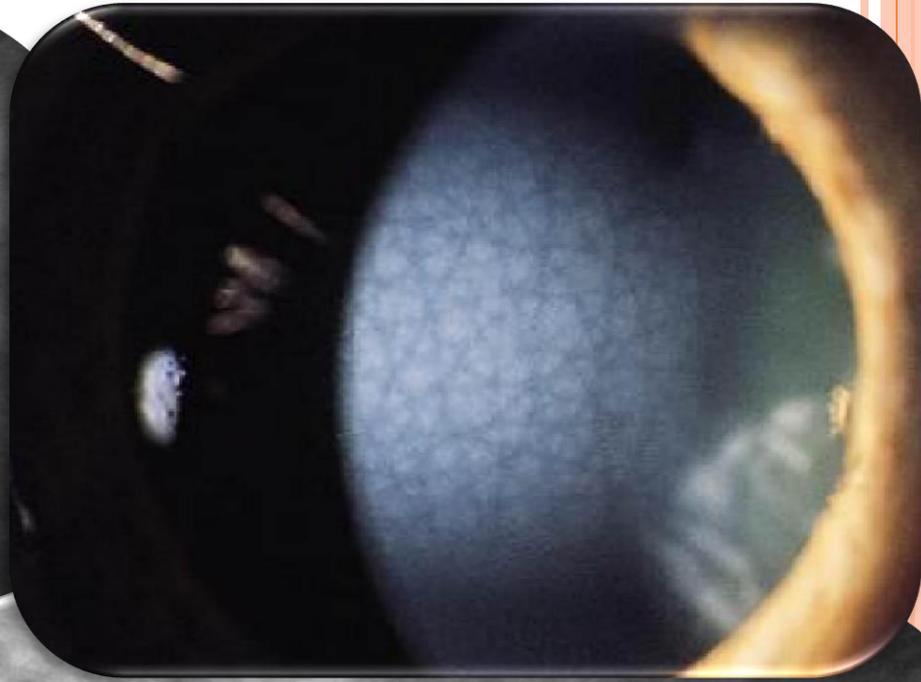
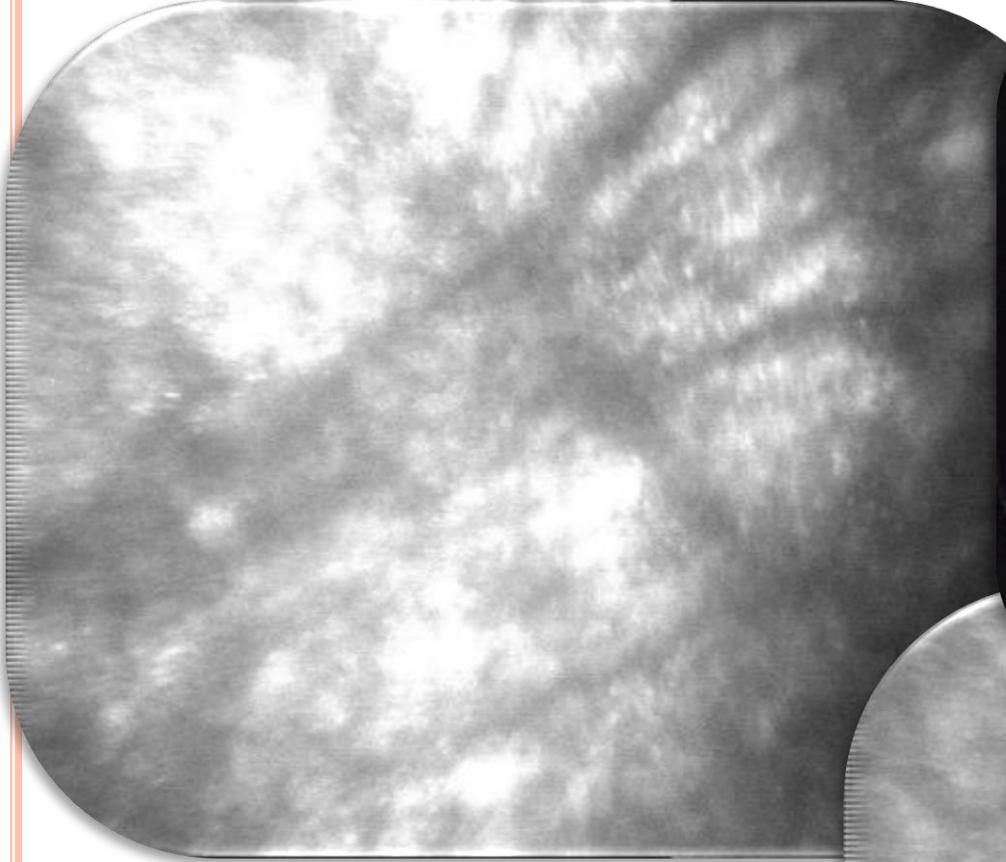


Anomala deposizione intra ed extracellulare di **colesterolo** e **fosfolipidi** (esterificati e non) nello stroma, nella Bowman e nello strato basale



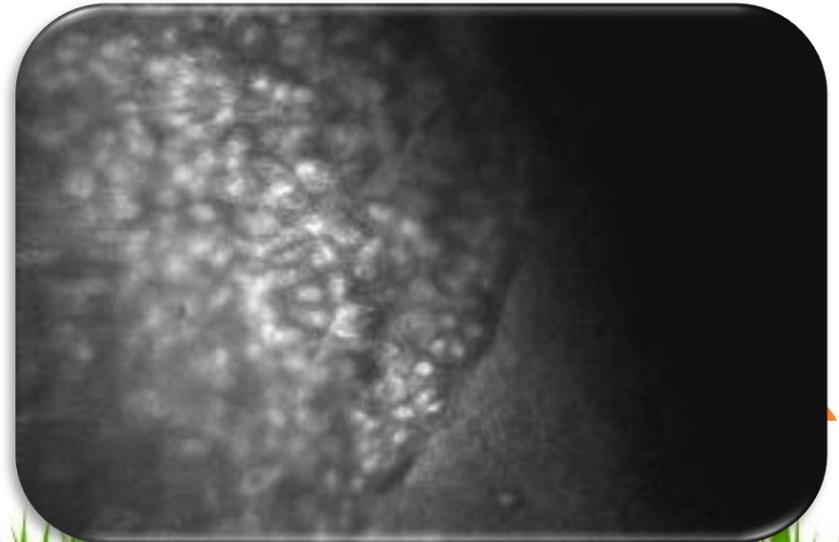
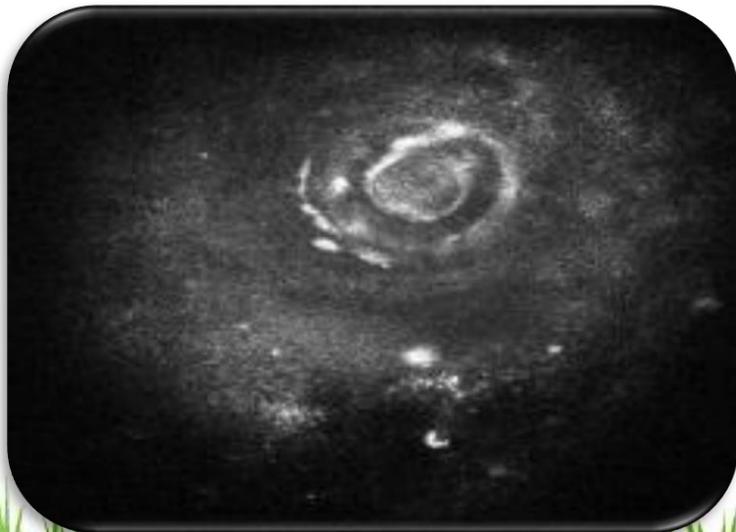
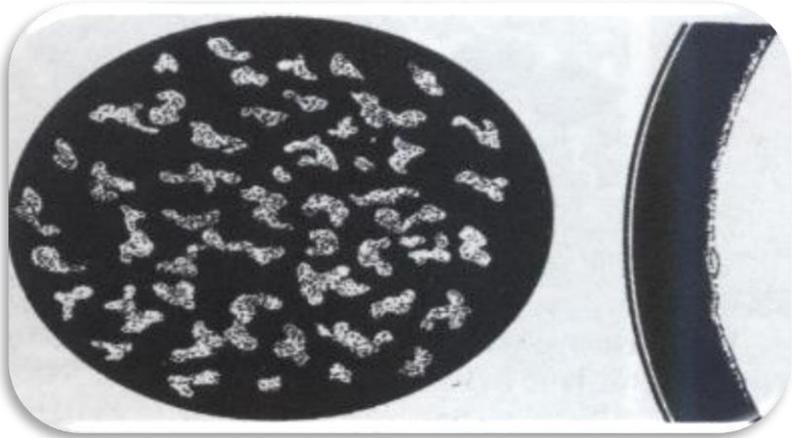
Sindrome di Fuchs



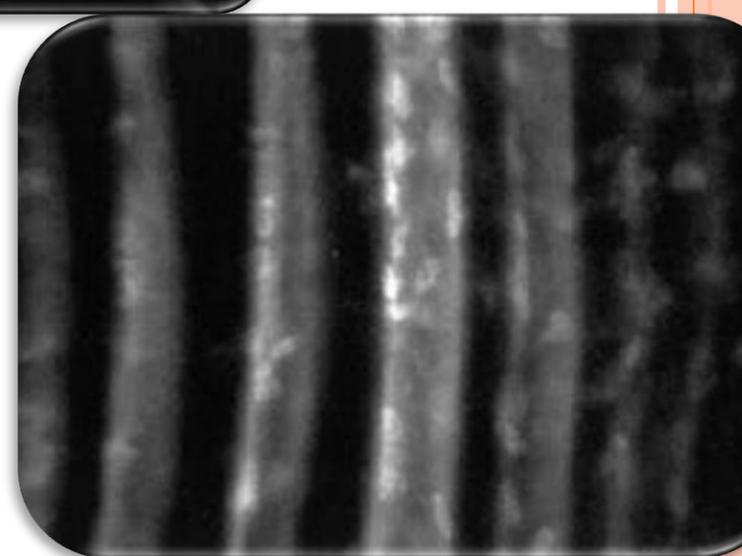
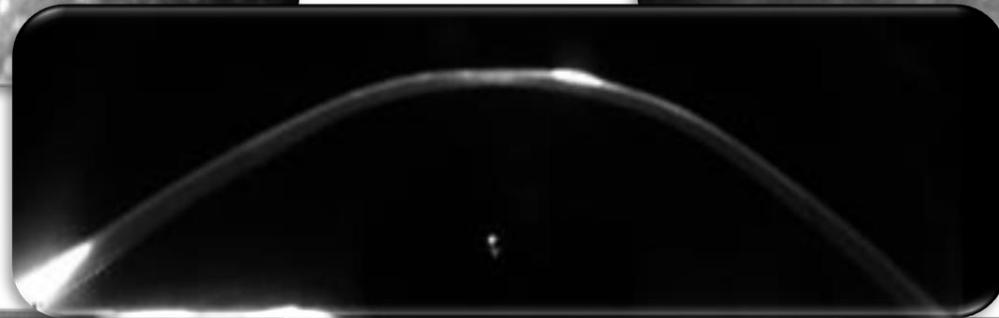
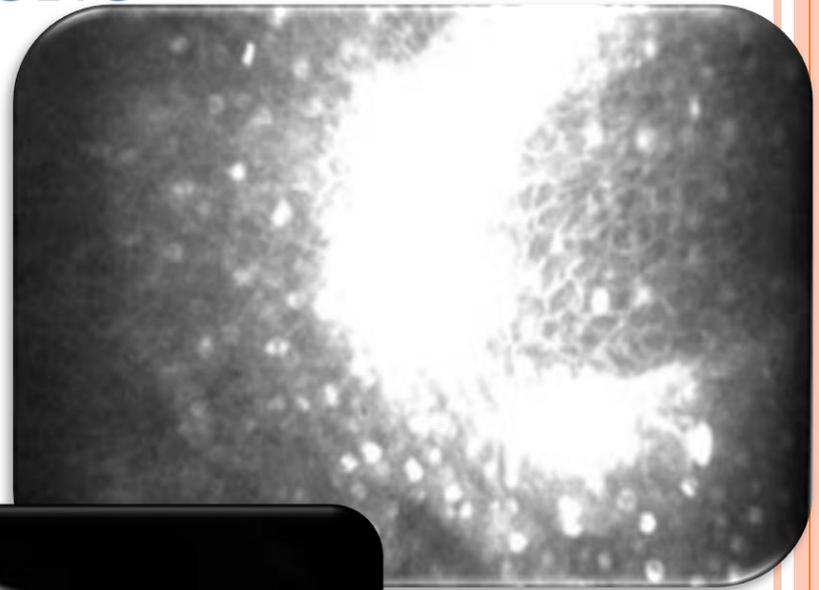
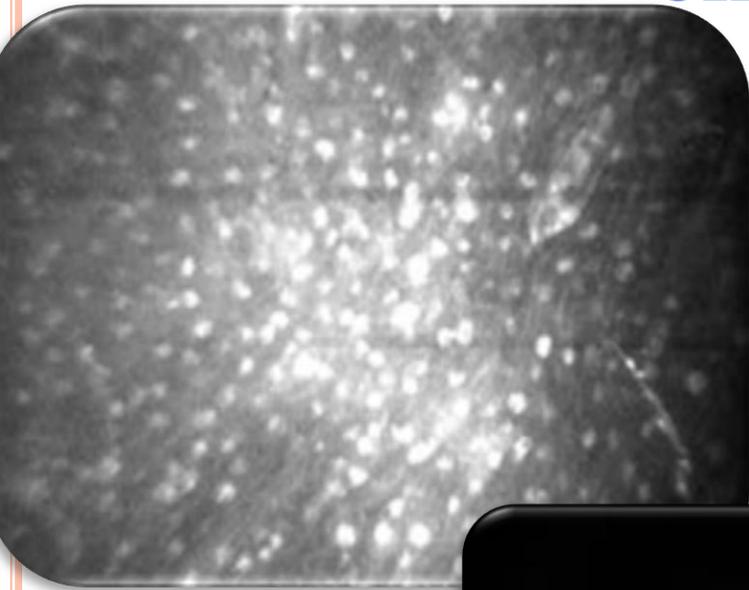


CROCODILE DYSTROPHY

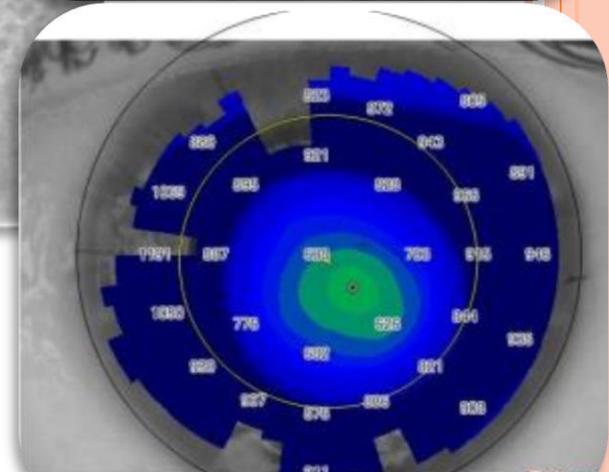
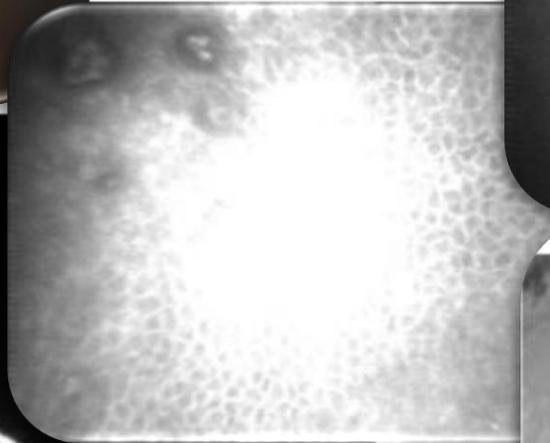
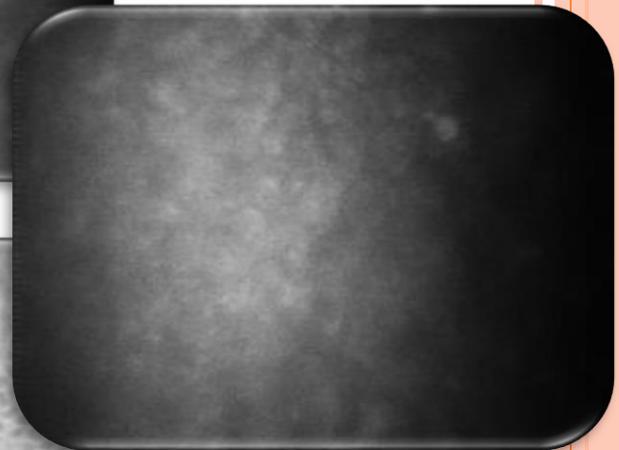
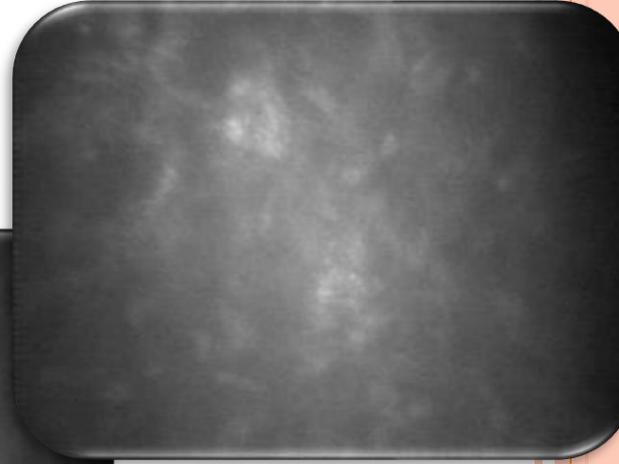
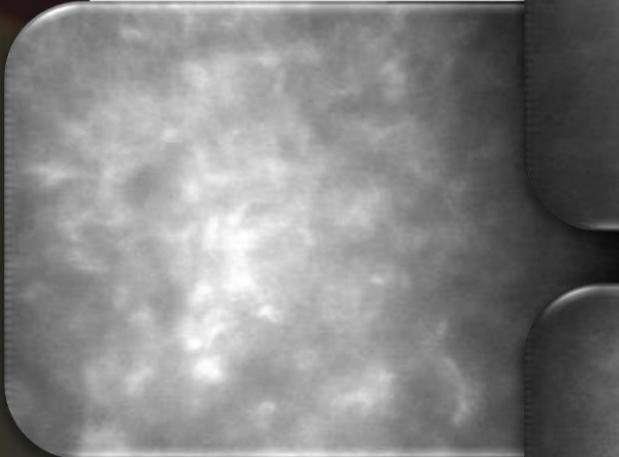
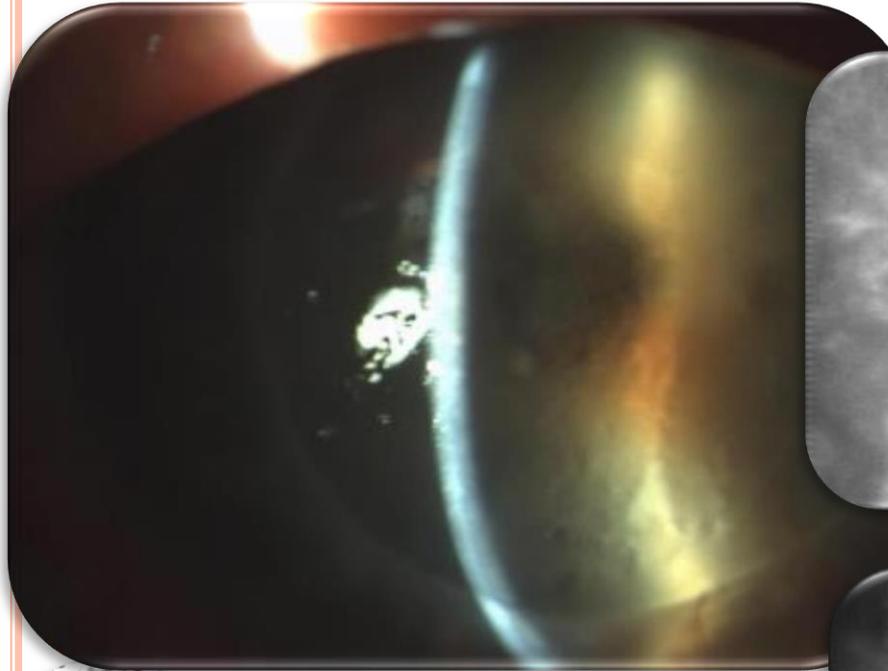
DISTROFIA POLIMORFA POSTERIORE



CHERATOCONO



CASO CLINICO



GRAZIE PER L'ATTENZIONE

