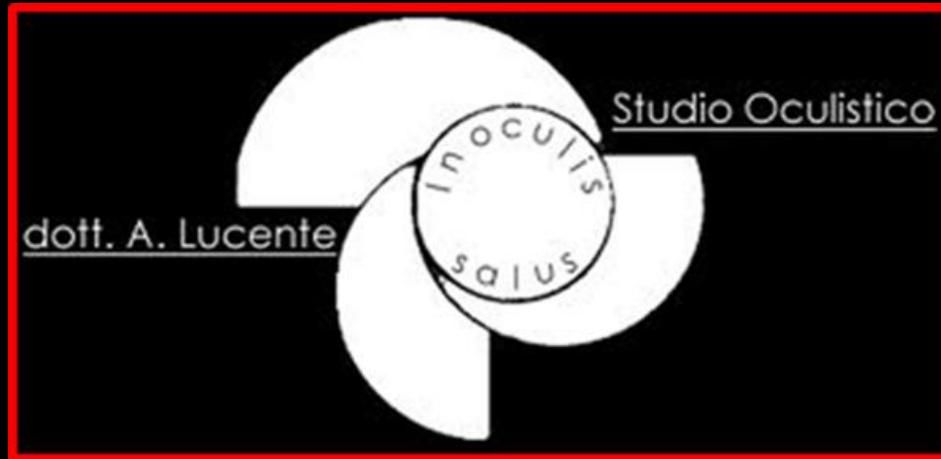
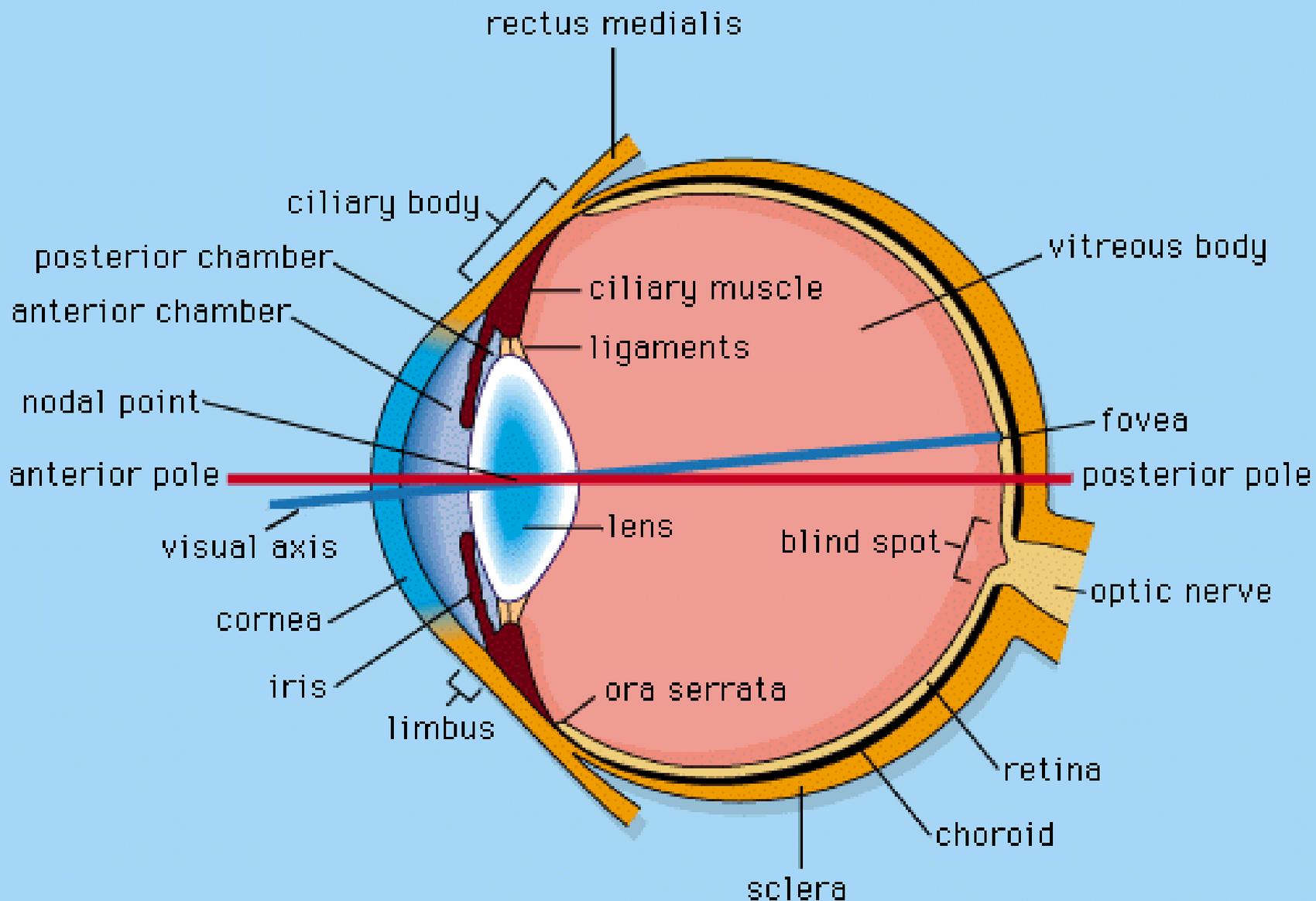


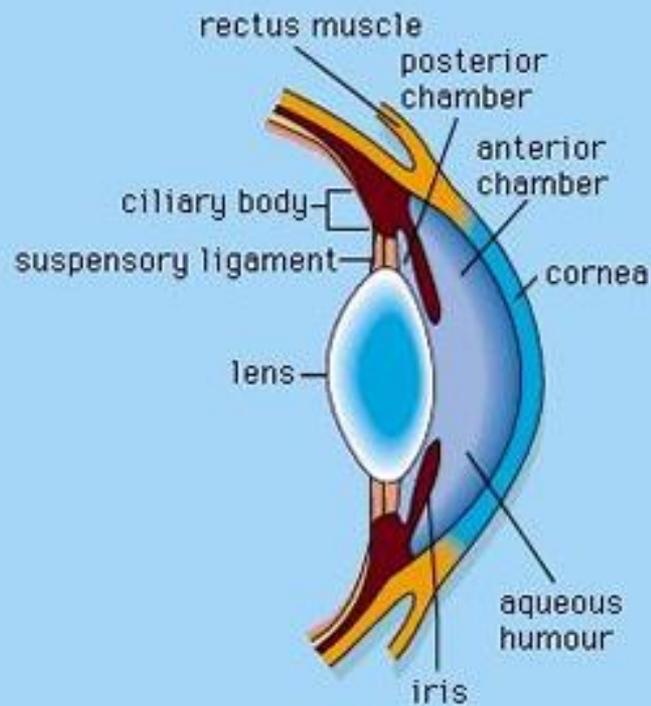
# Biomeccanica e glaucoma



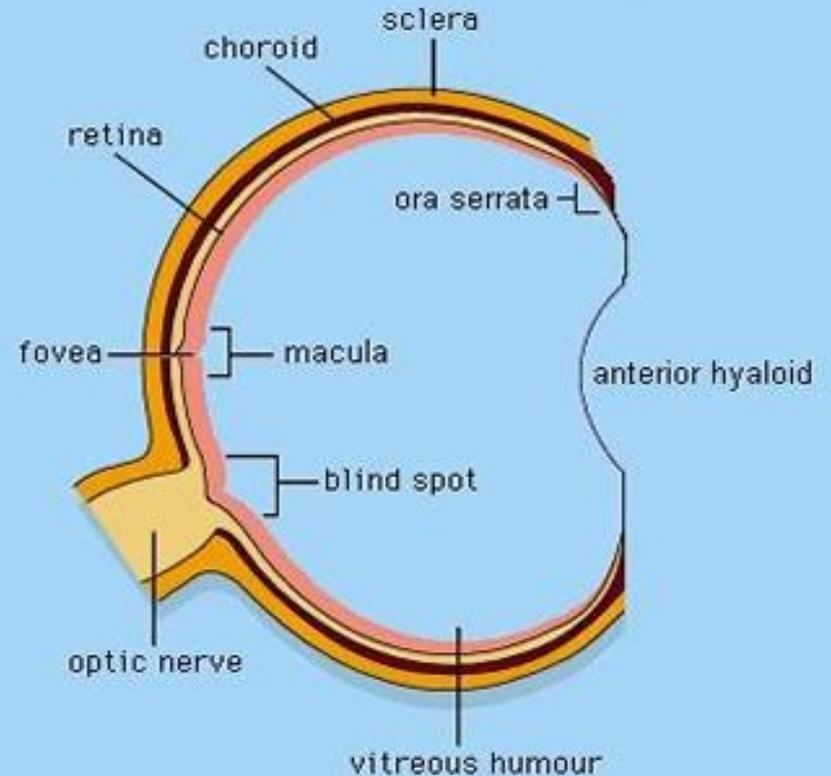
*No relationships to disclosure*



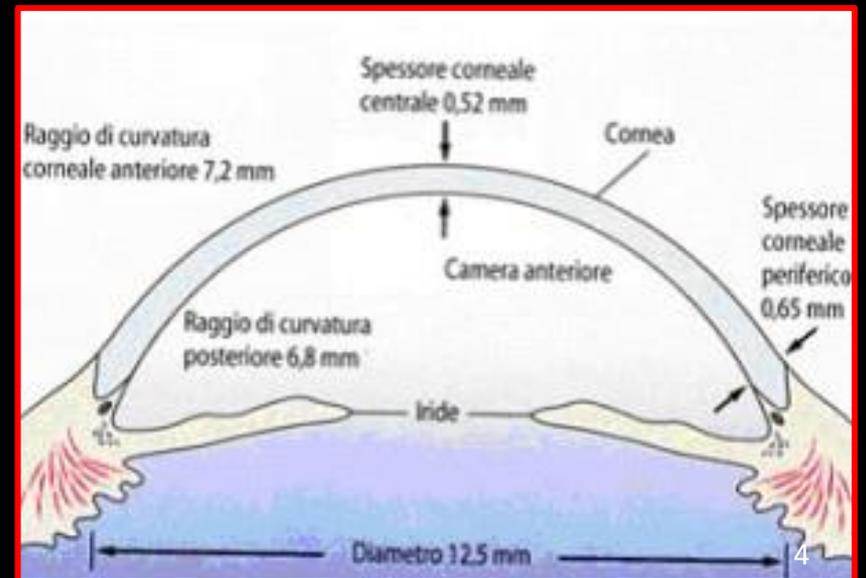
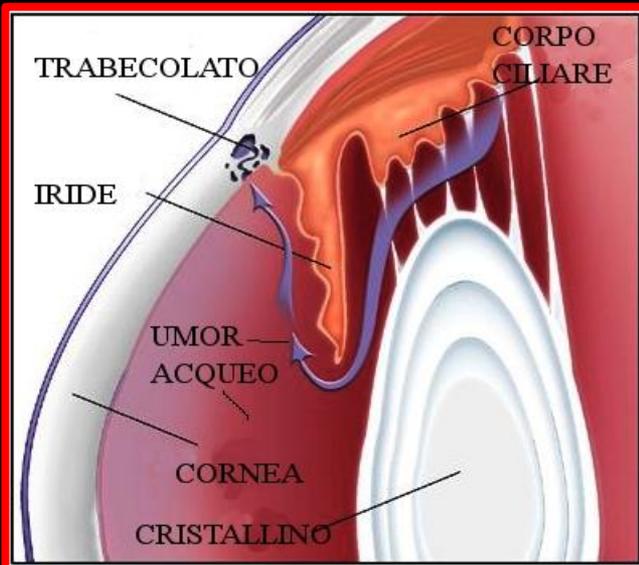
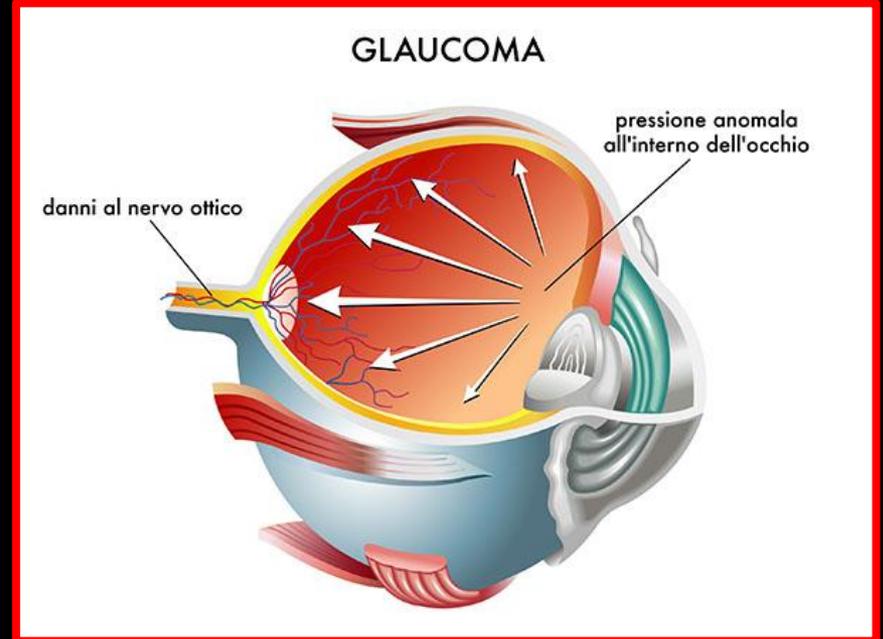
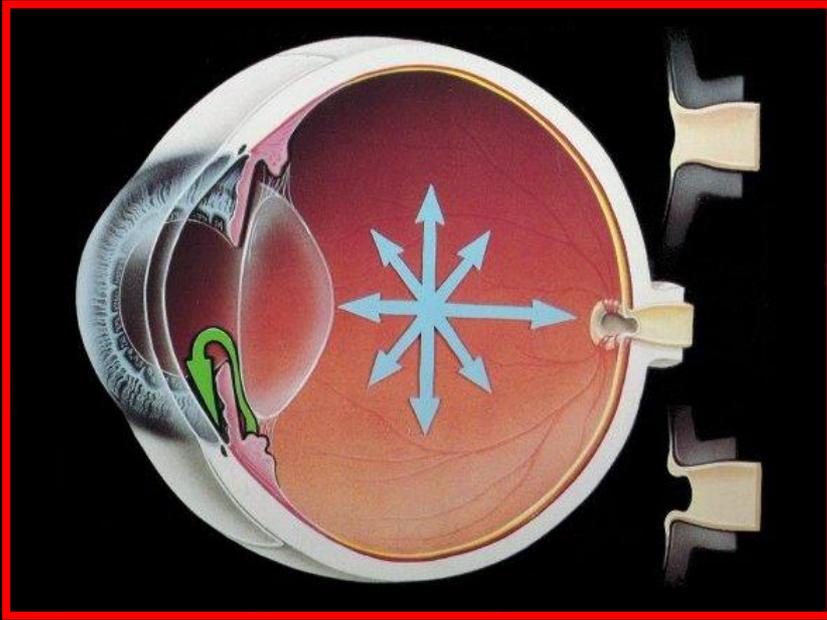
## The Anterior Segment



## The Posterior Segment

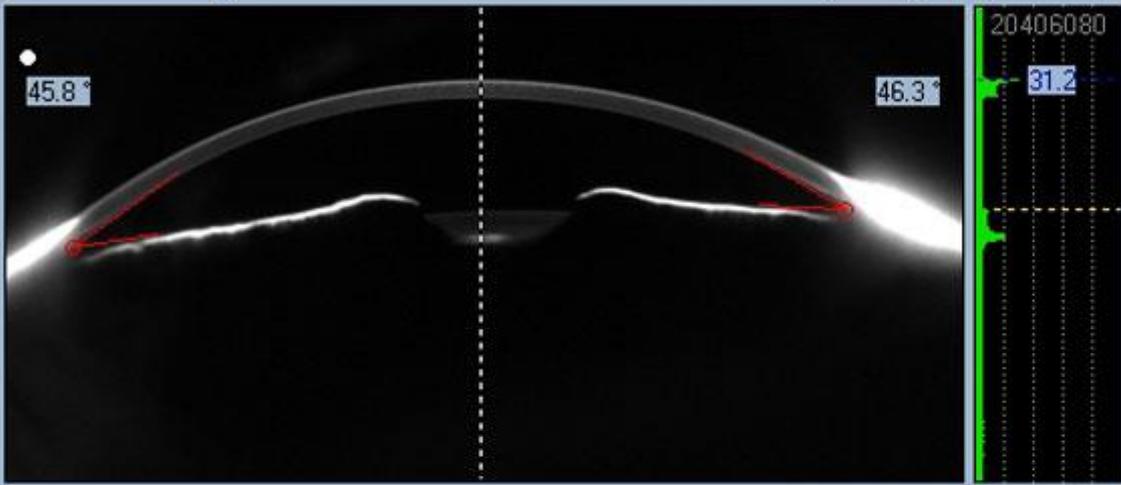


# Glaucoma



Right eye	9/25	Segment: 121° - 301°		
	10/25	Segment: 129° - 309°		
	11/25	Segment: 137° - 317°		
	12/25	Segment: 144° - 324°		

Last Name: Trazza  
 First Name: Silvia  
 ID: astigmatismo  
 Date of Birth: 07/28/1977 Eye: Right  
 Exam Date: 09/12/2012 Time: 19:36:14



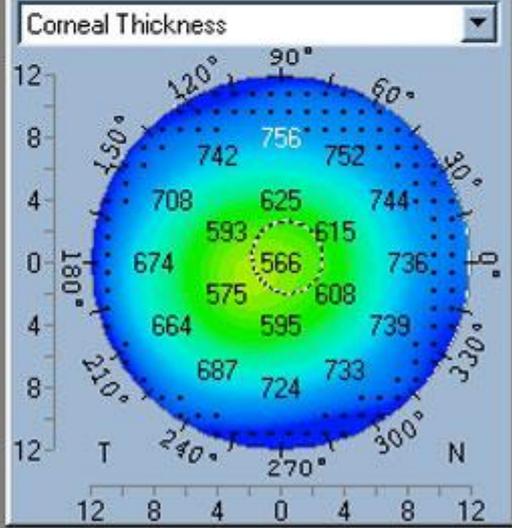
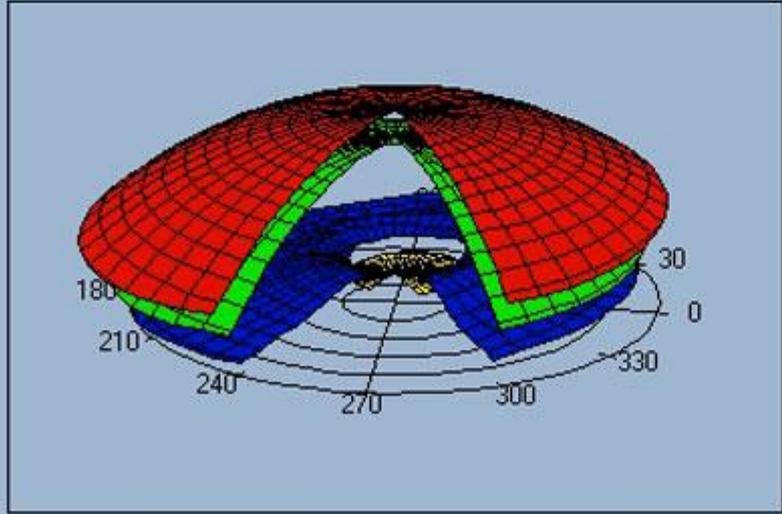
90° K1: 42.0D Astig: 2.2D  
 180° K2: 44.2D Q-val: -0.37  
 270° Axis: 18.2° (flat) QS: OK

Pachy: x[mm] y[mm]  
 Pupil Center: 569µm + +0.21 +0.18  
 Thinnest Locat.: 560µm o -0.80 -0.40

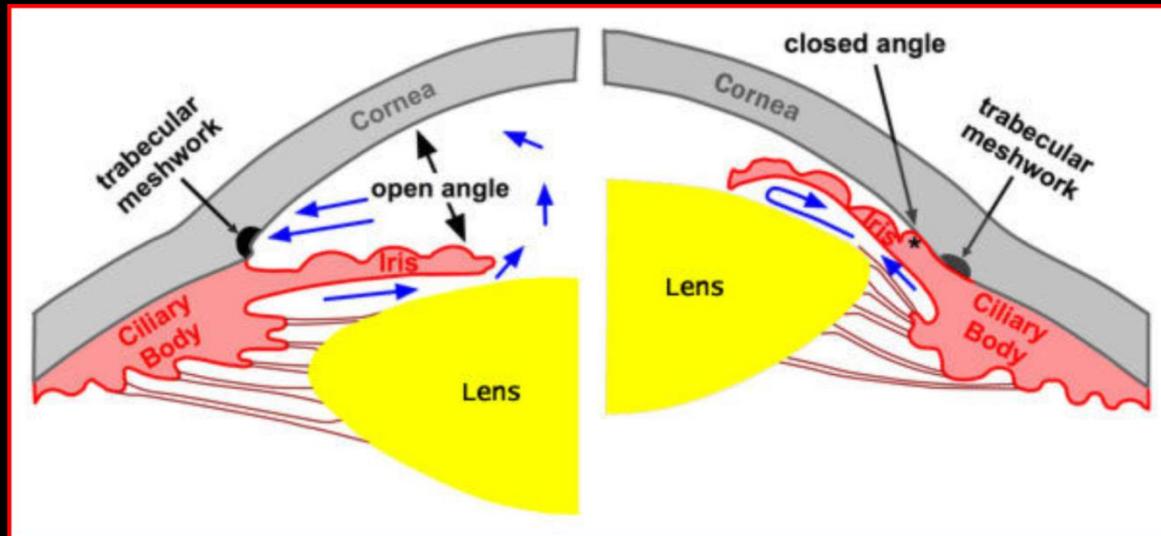
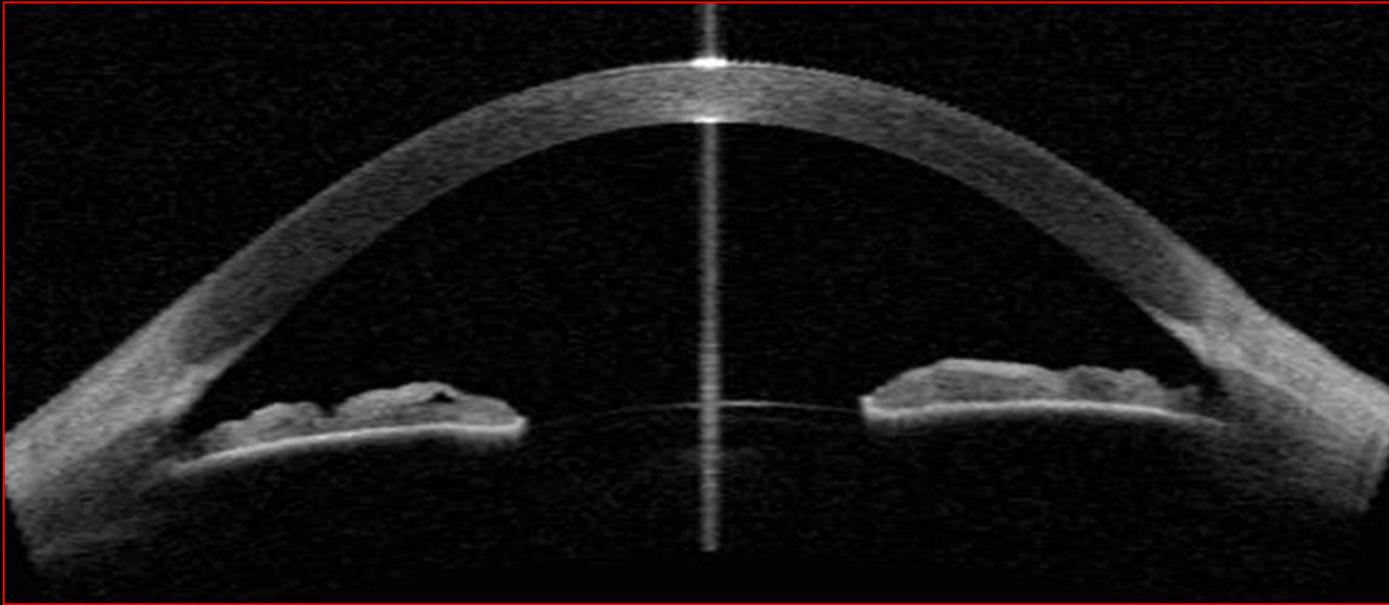
Chamb. Volume: 152mm³ Angle: 44.6°  
 ACD (Int.): 2.75mm Pupil D: 2.27mm  
 Enter IOP (cor): Lens T:



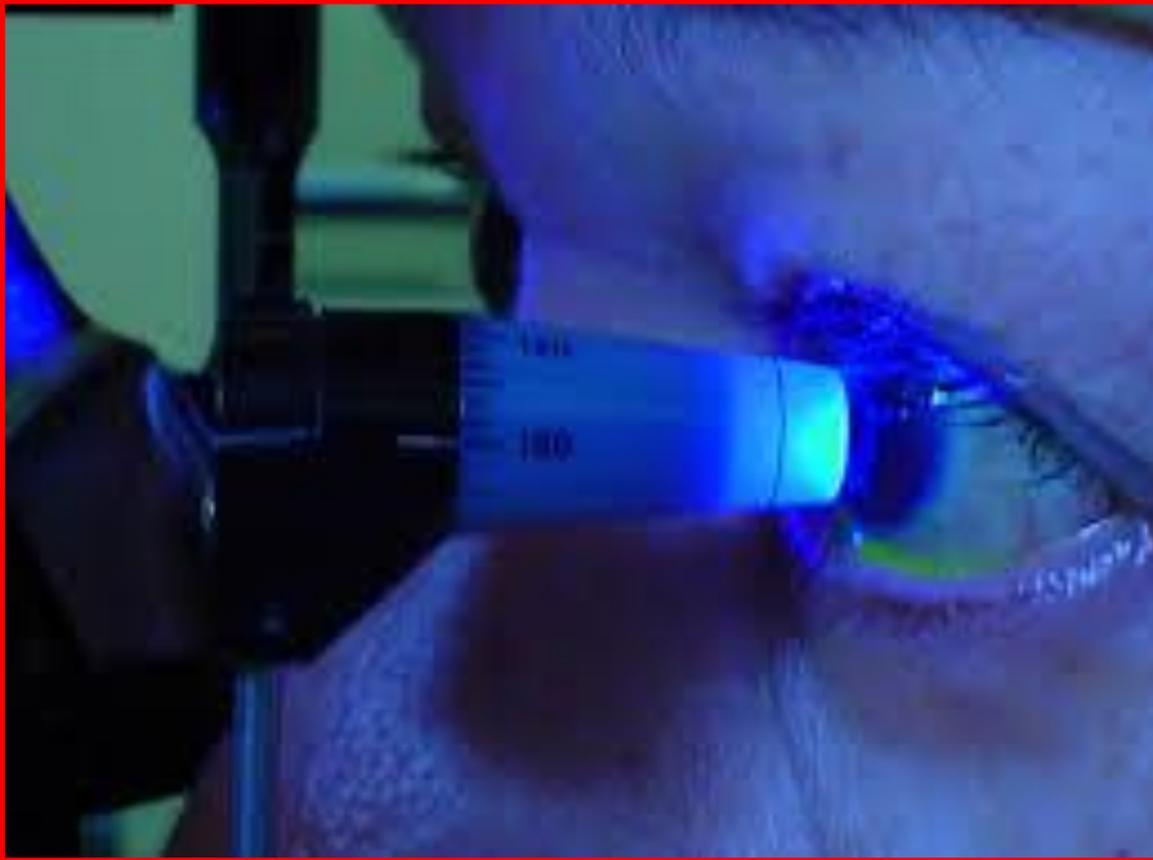
- |              | Show                                | Fill                                |
|--------------|-------------------------------------|-------------------------------------|
| Cornea Front | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Cornea Back  | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Iris         | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Lens Front   | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Lens Back    | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Scale        | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |
| Cutout Width | 60°                                 |                                     |
| Cutout Pos   | 270°                                |                                     |
- Normalize Animate



# 1° Target di studio: Tonometria



# Tonometria ad applanazione



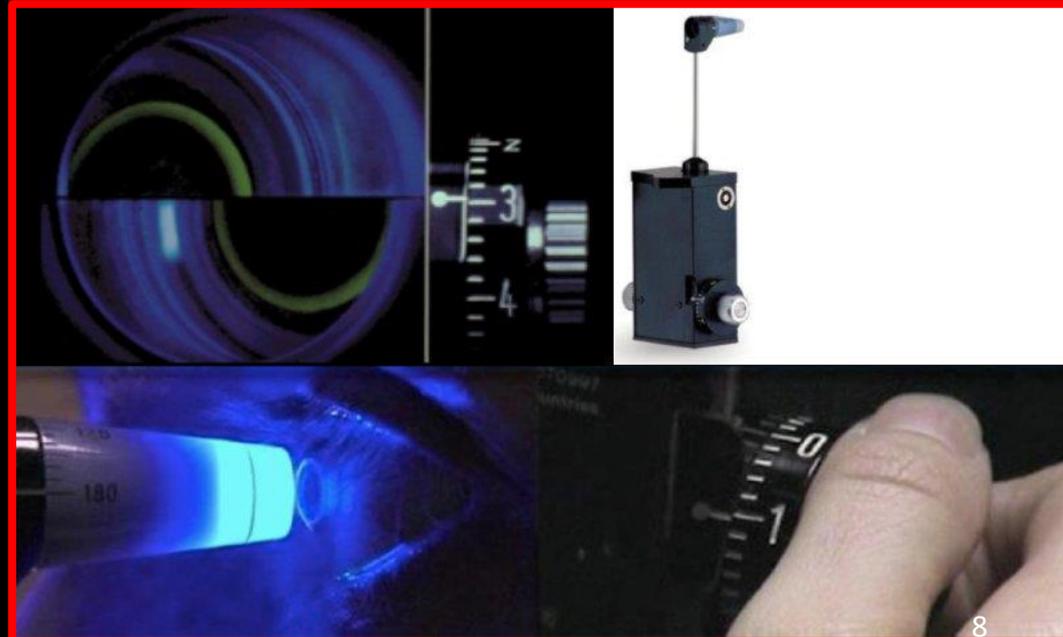
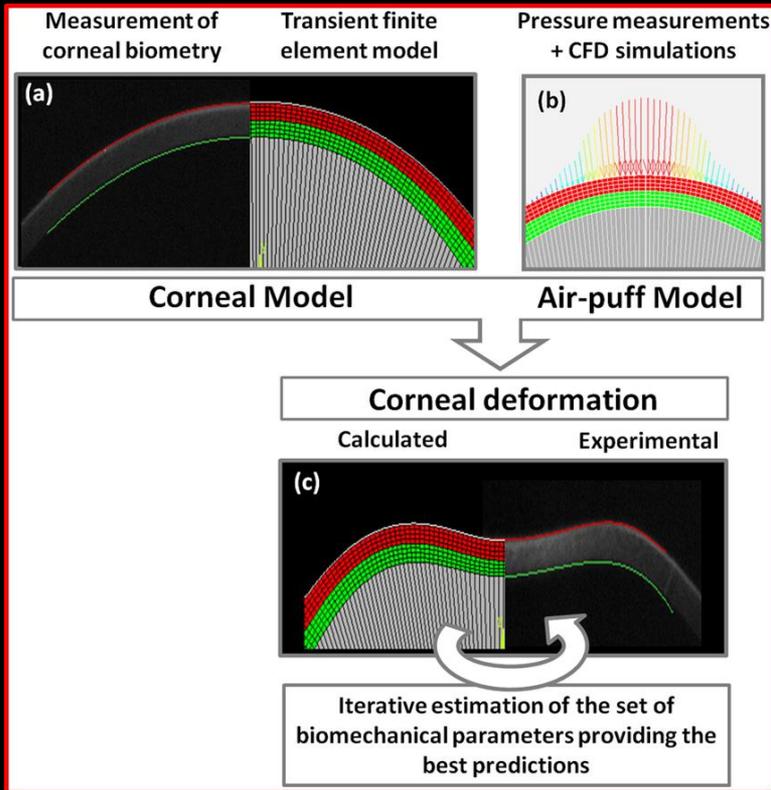
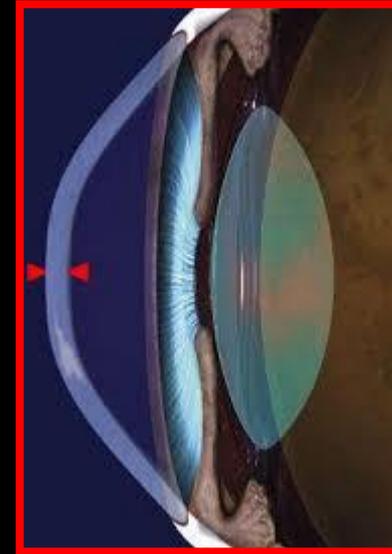
Un sistema a rigidità flessionale risponde con una resistenza propria alle sollecitazioni di forze esterne. Un trampolino si flette secondo la seguente formula:

$$S = \frac{4 l^3 F}{E a^3 b}$$

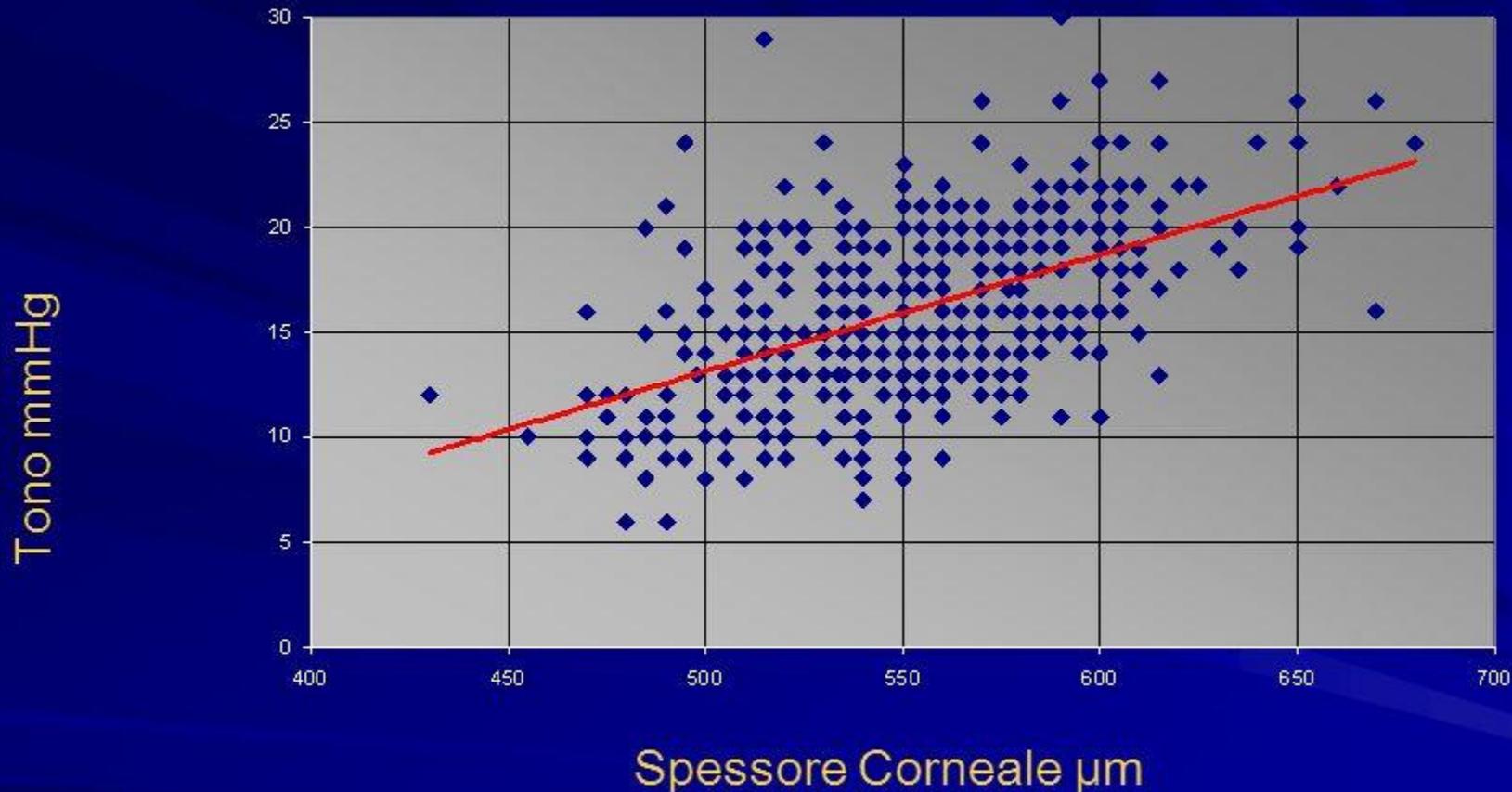
S = saetta di flessione;  
F = forza esterna;  
E = modulo elastico proprio della struttura;  
l = lunghezza del trampolino;  
a = spessore del trampolino;  
b = larghezza del trampolino.



# Tonometria



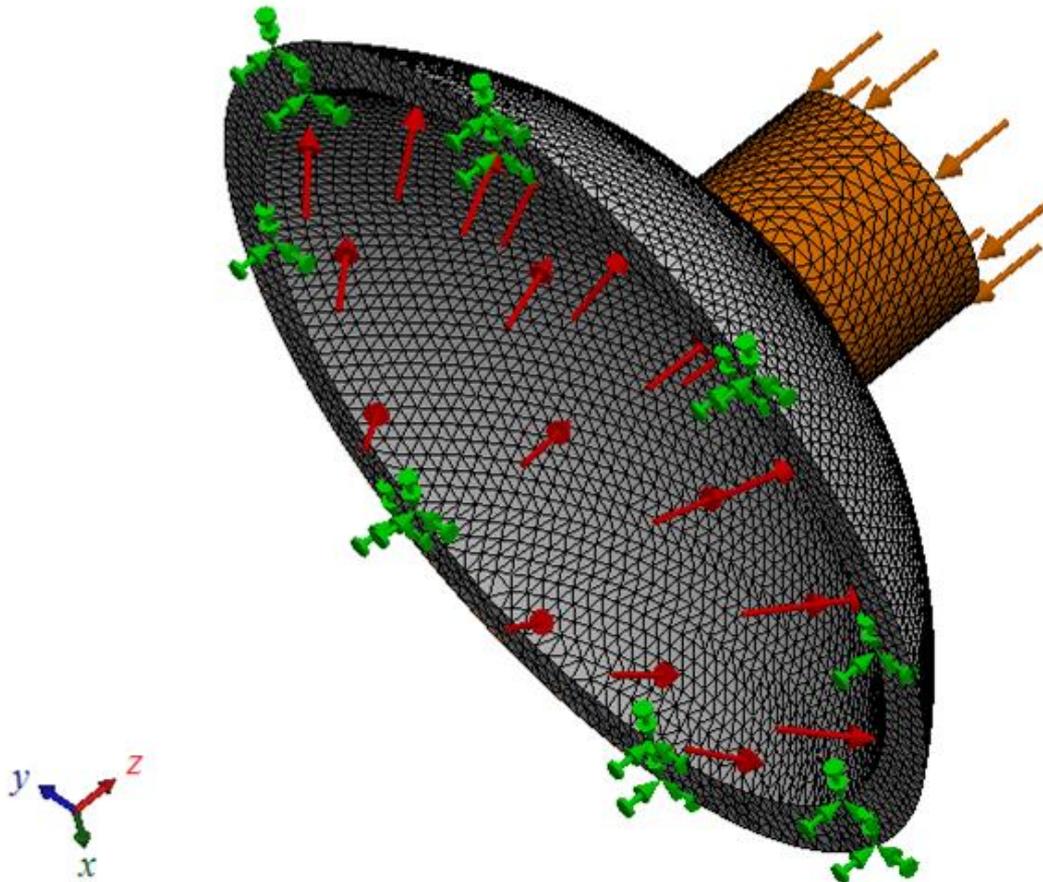
Dipendenza Tono-Spessore (514 paz. Osservati)



$$\text{Tono} = -14,63 + 0,056 \text{ Paki} ; (\text{tono} = a + b \text{ Paki} + e)$$

$\pm 0,56 \text{ mmHg ogni } 10 \mu\text{m}$   
**Pachimetria media 554 μm**

Rappresentazione dei vincoli e dei carichi che agiscono sul modello corneale. Modello ad elementi finiti FEM della cornea.

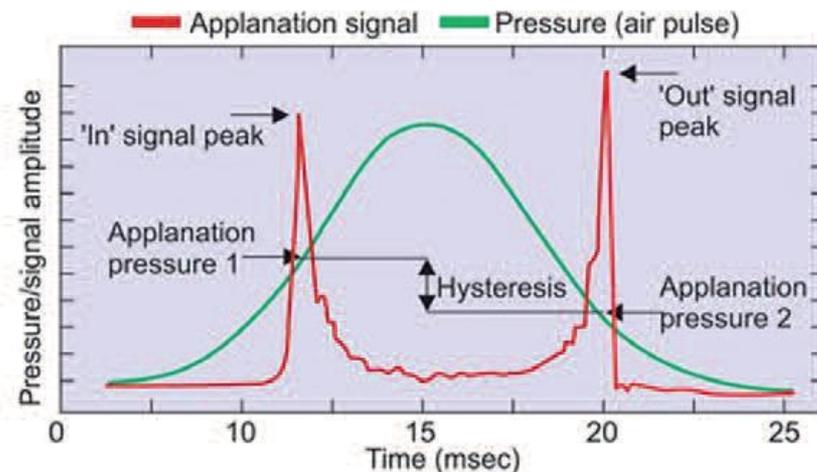
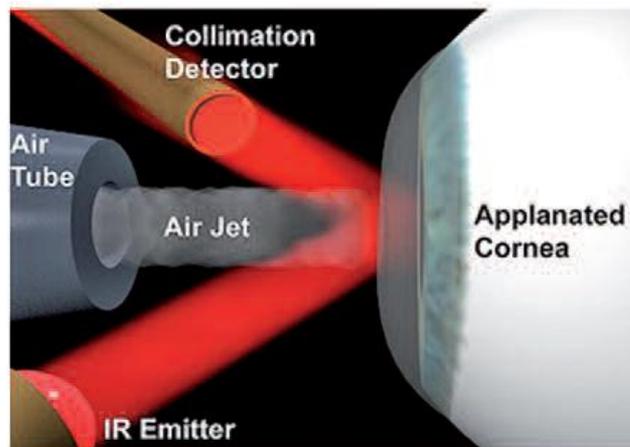
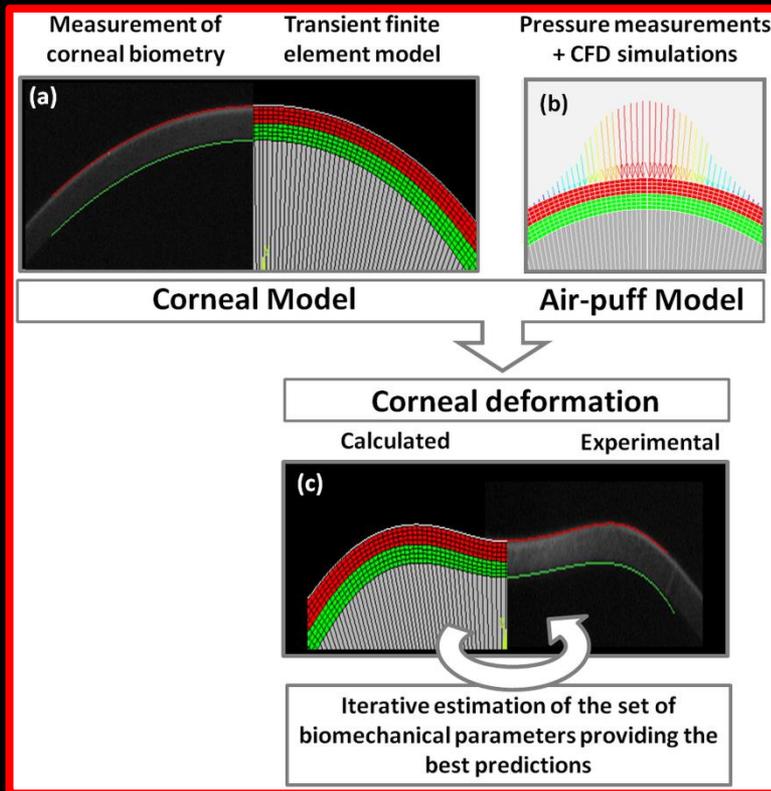


(da Fabio Vilella)

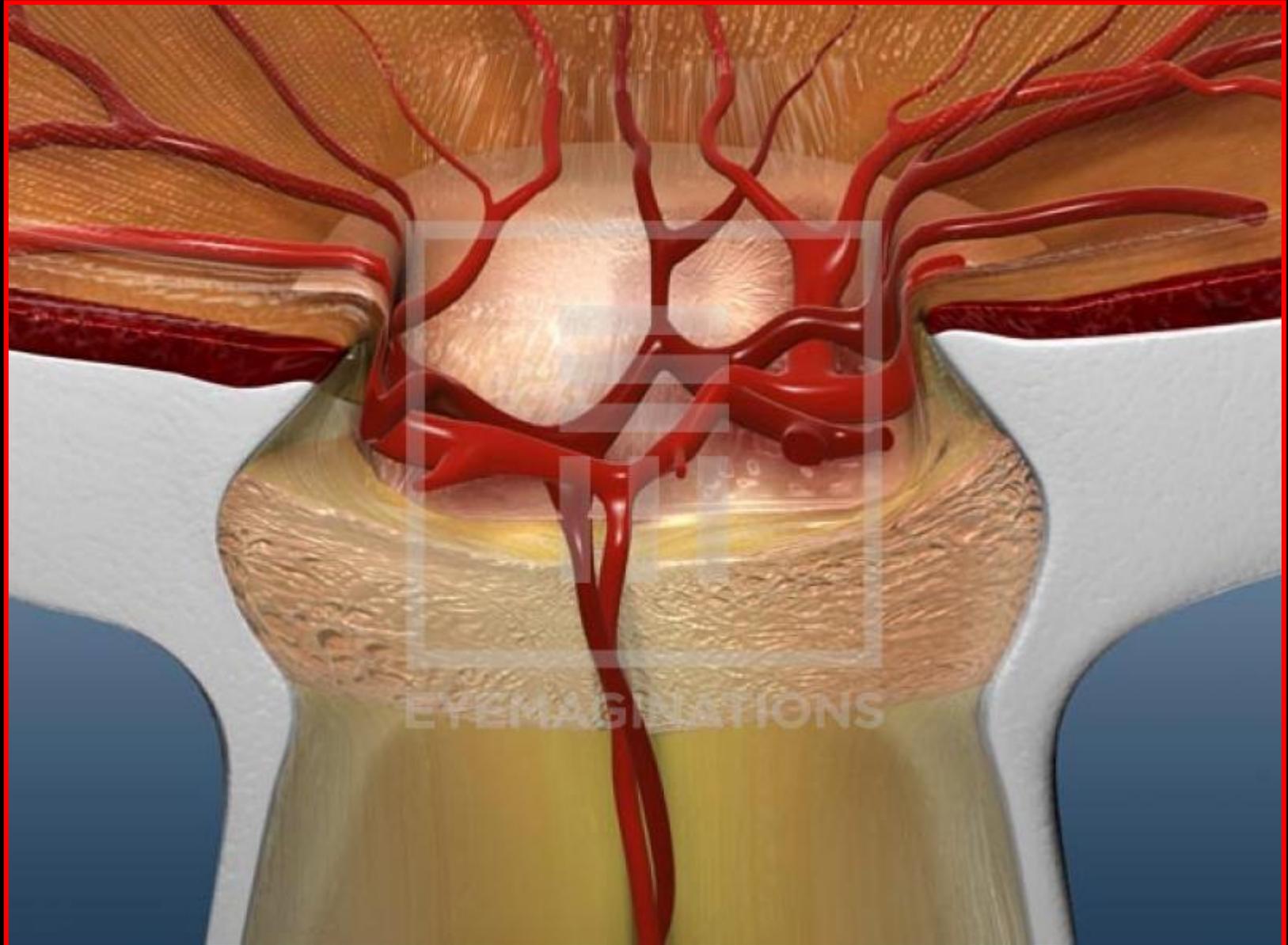
# Hystéresis = ritardo

Misura indiretta della resistenza corneale alla deformazione esternamente indotta tramite un soffio d'aria

Un occhio con uno spessore corneale centrale di 600  $\mu\text{m}$  e IOP  $\sim 30$  mmHg ha un rischio del 9,1% di sviluppare glaucoma; un occhio con una IOP  $\sim 20$  mmHg e 500  $\mu\text{m}$  di spessore ha un rischio del 20,7% (Gordon et al Arch Ophthalmol. 2002)



# 2° Target Studio: Papilla Ottica ONH



02.02.11 09:48:48



@amedeolucente.it

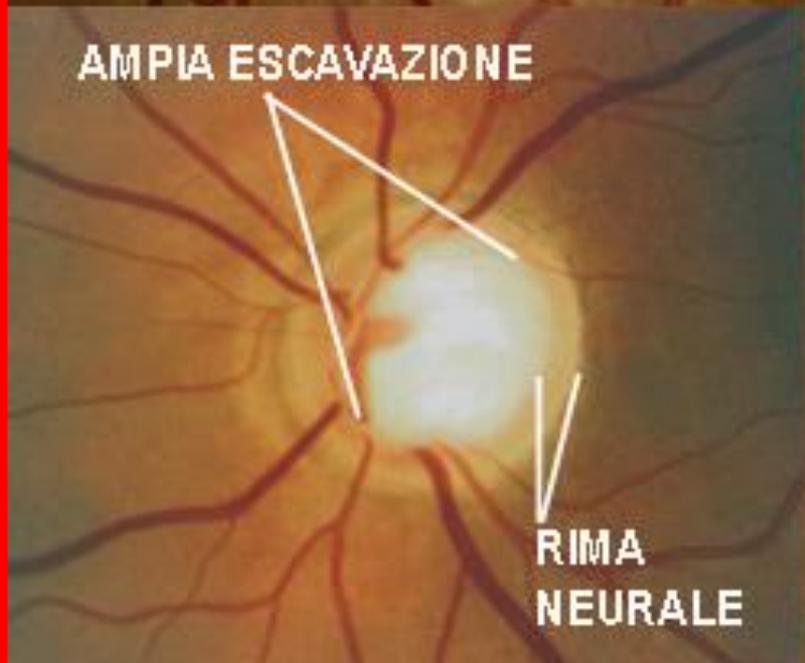
PAPILLA POCO ESCAVATA



PAPILLA NORMALE



AMPIA ESCAVAZIONE



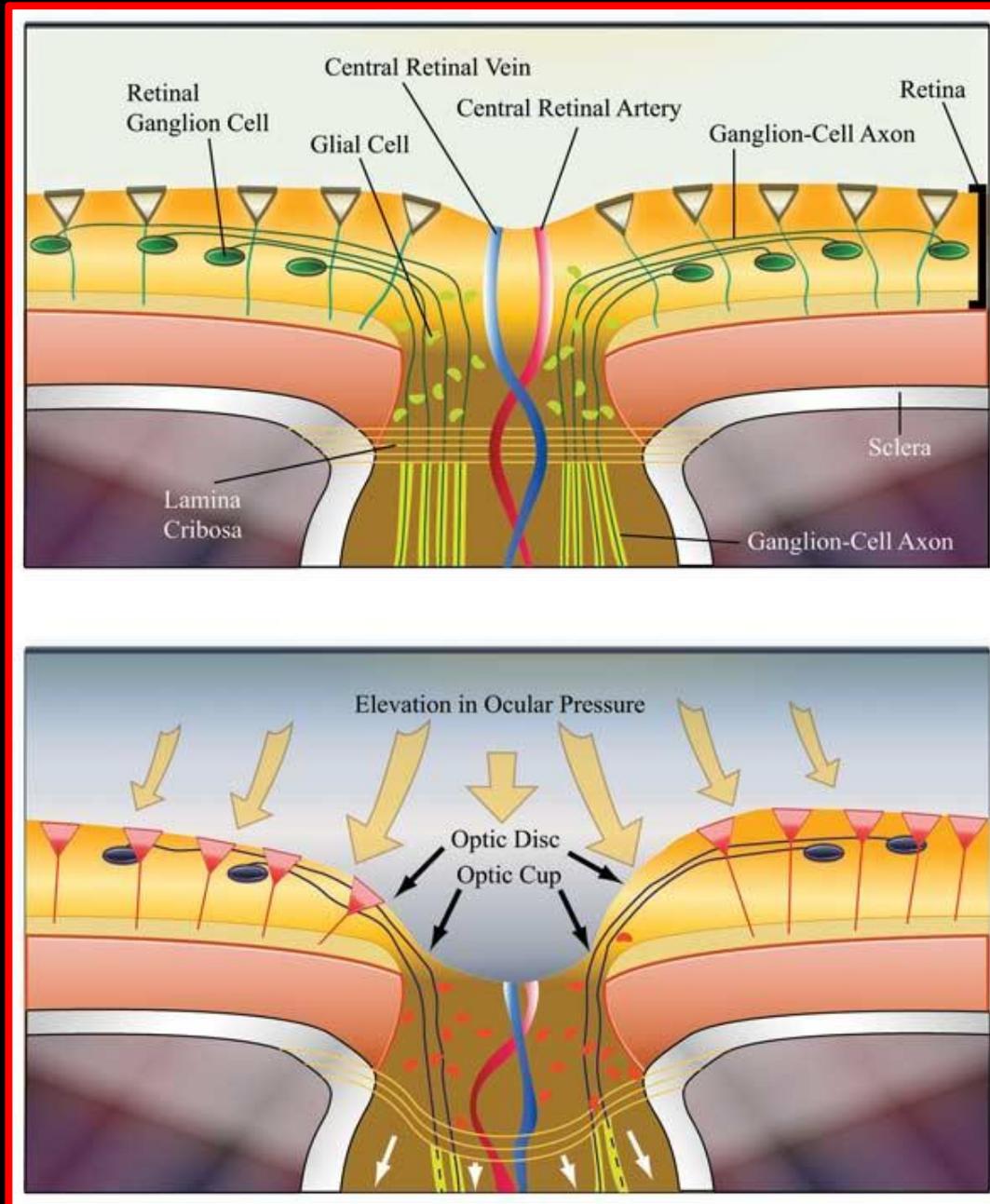
RIMA  
NEURALE

PAPILLA GLAUCOMATOSA  
CON ESCAVAZIONE AVANZATA

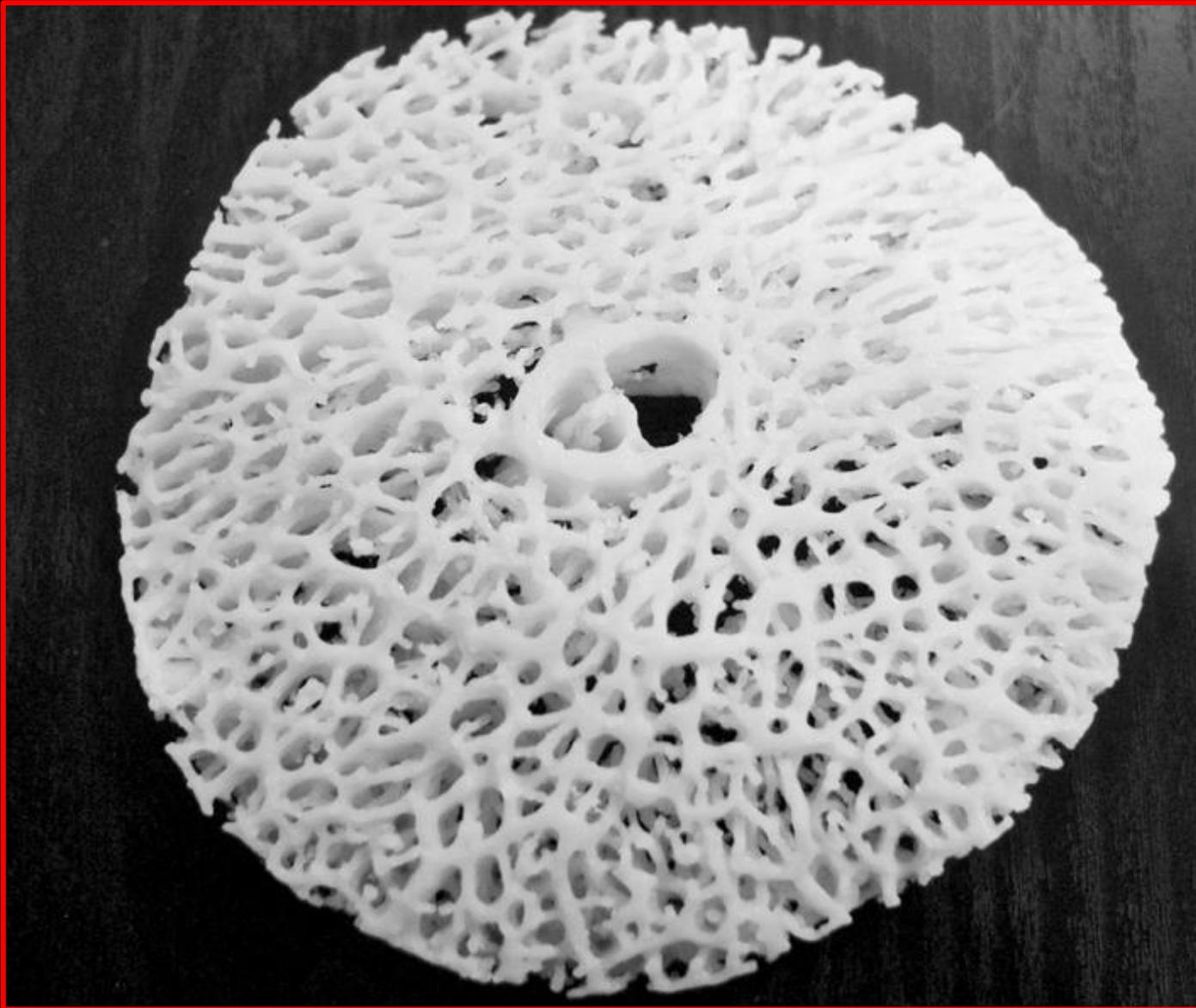


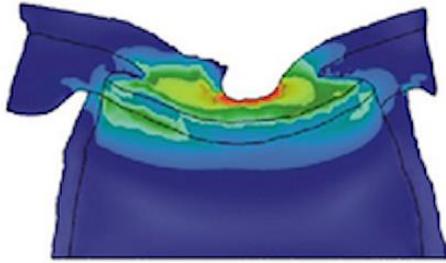
RIMA NEURALE SCOMPARSA

# ONH prima e dopo aumento della IOP (www.powerpak.com)



# Ricostruzione plastica della lamina cribrosa (Crawford Downs et. al.)

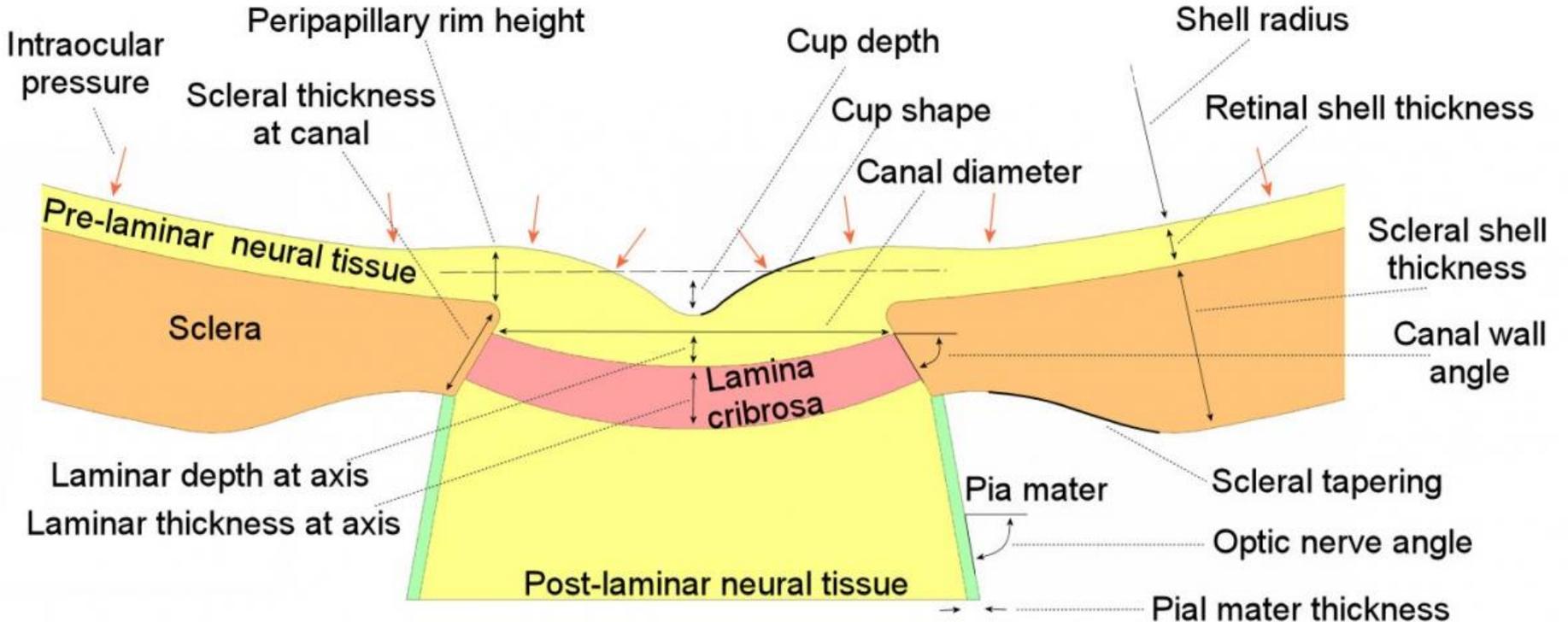
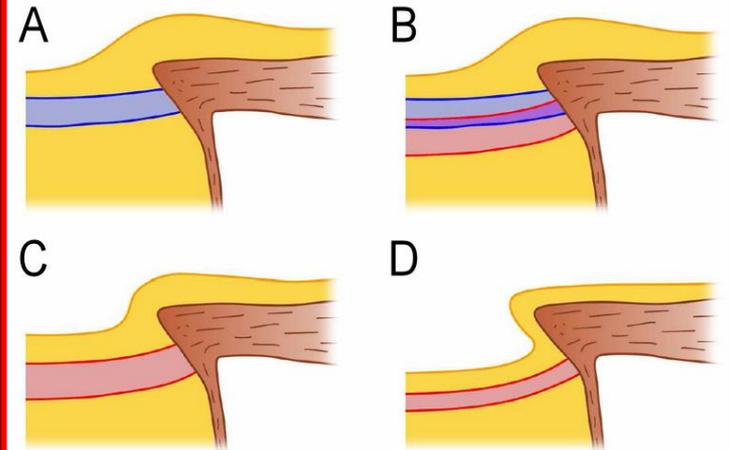




Deformations  
(shearing strain)

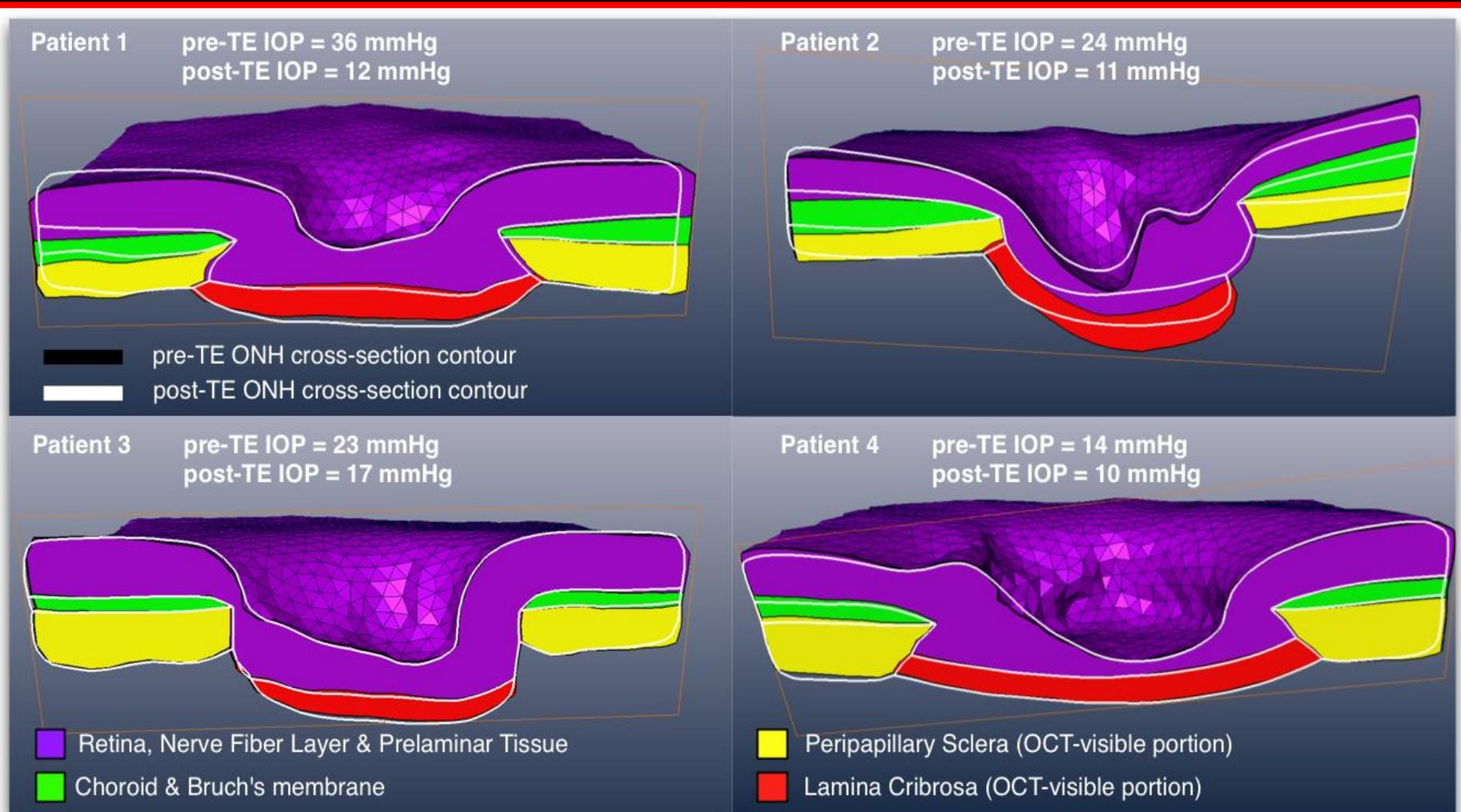


Forces  
(von Mises stress)



# 3D Deformation Mapping of the Human Optic Nerve Head In Vivo

da: Michael J. Girard et al ARVO 2012

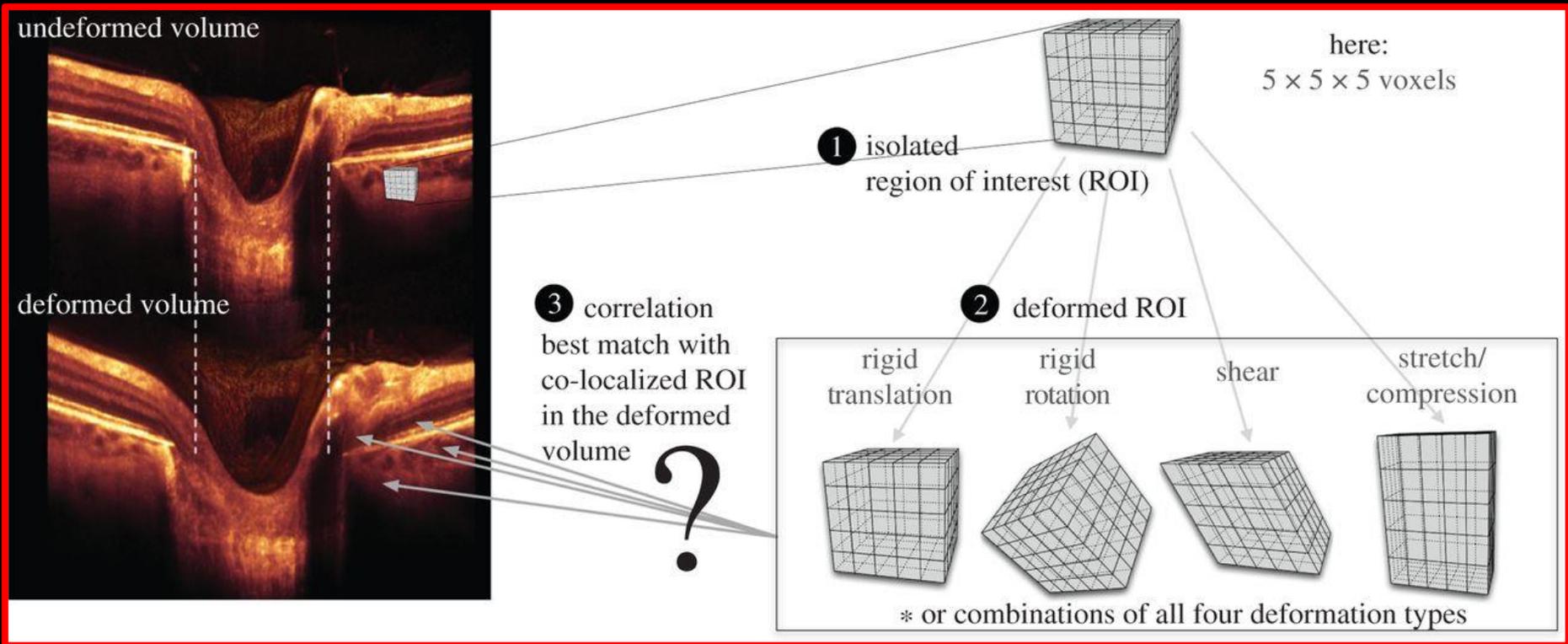


**Figure.** 3D deformation mapping of the human ONH following IOP-lowering by TE. Cross-section contours of the ONH are shown pre- (in black) and post- (in white) TE. For better visualization, ONH deformations were exaggerated 2 times. Only the OCT-visible portions of the peripapillary sclera and lamina cribrosa are represented.

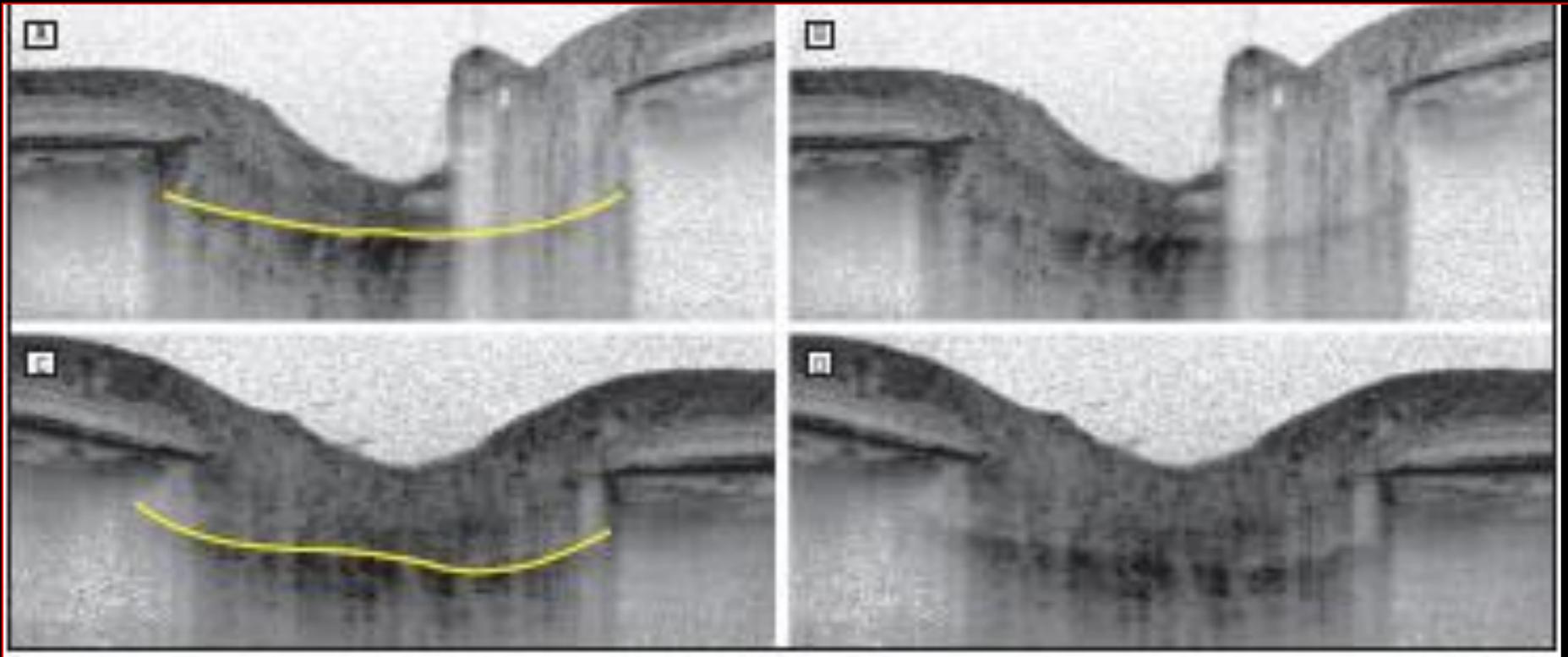
# In vivo optic nerve head biomechanics: performance testing of a three-dimensional tracking algorithm

Michaël J. A. Girard, Nicholas G. Strouthidis, Adrien Desjardins, Jean Martial Mari, C. Ross Ethier

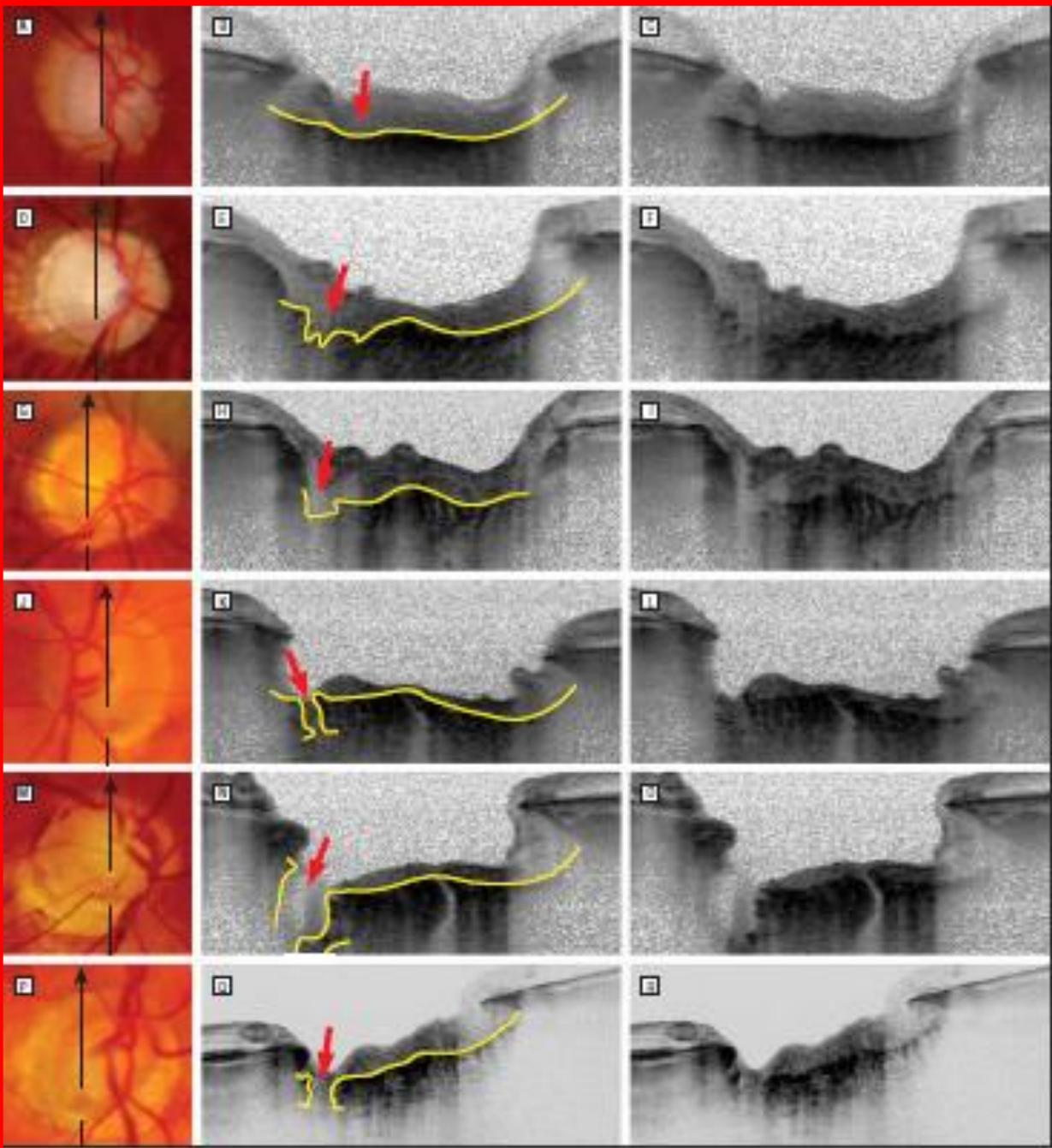
DOI: 10.1098/rsif.2013.0459 . Published 24 July 2013 **The Royal Society**





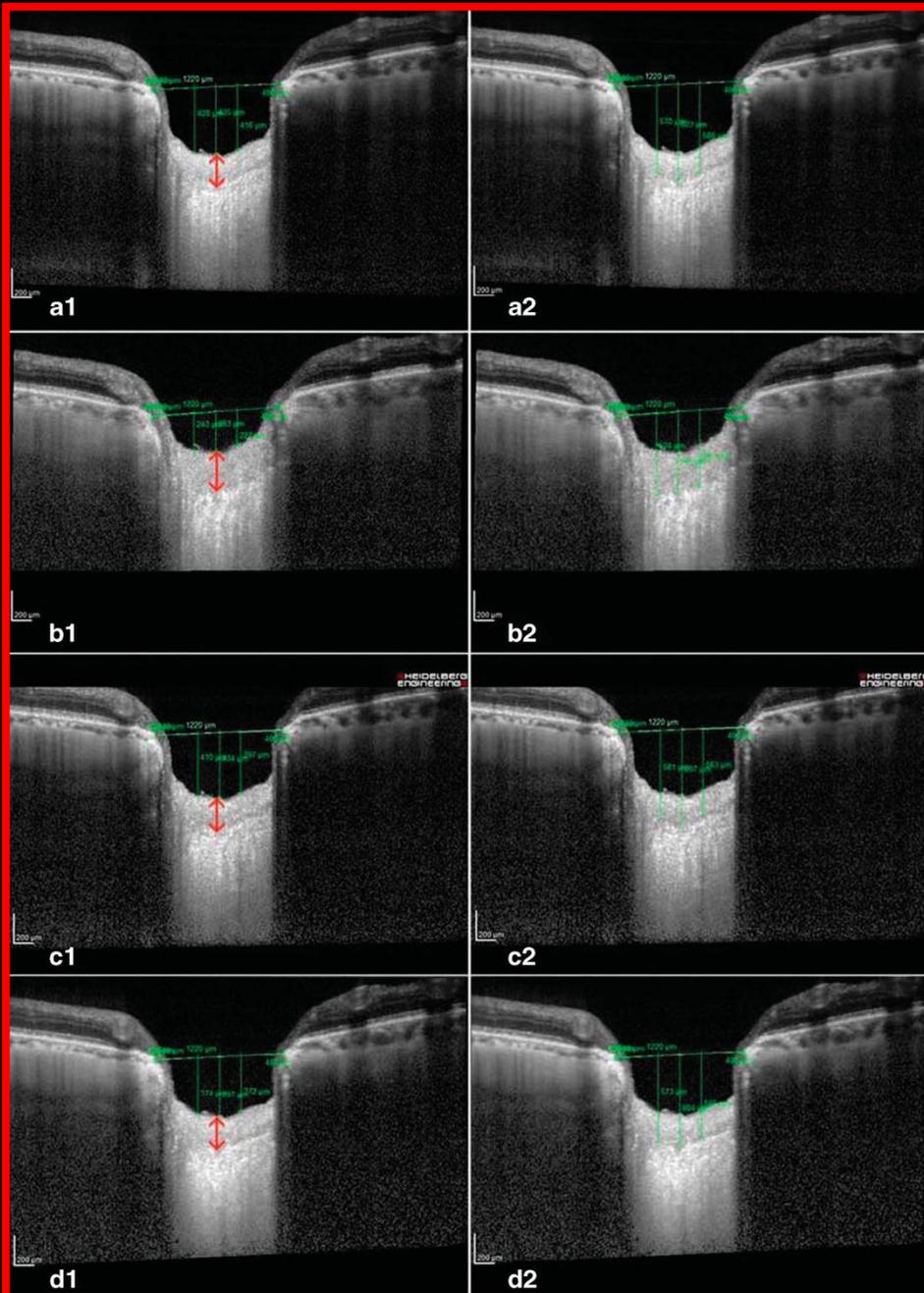


Horizontal (A) and vertical (C) enhanced depth imaging optical coherence tomographic scans of a sample healthy case (**right eye**) and the same images as in A and C without the labels (B and D, respectively). Lines indicate anterior lamellar surface. da: *Saman Kiumehr et al.*



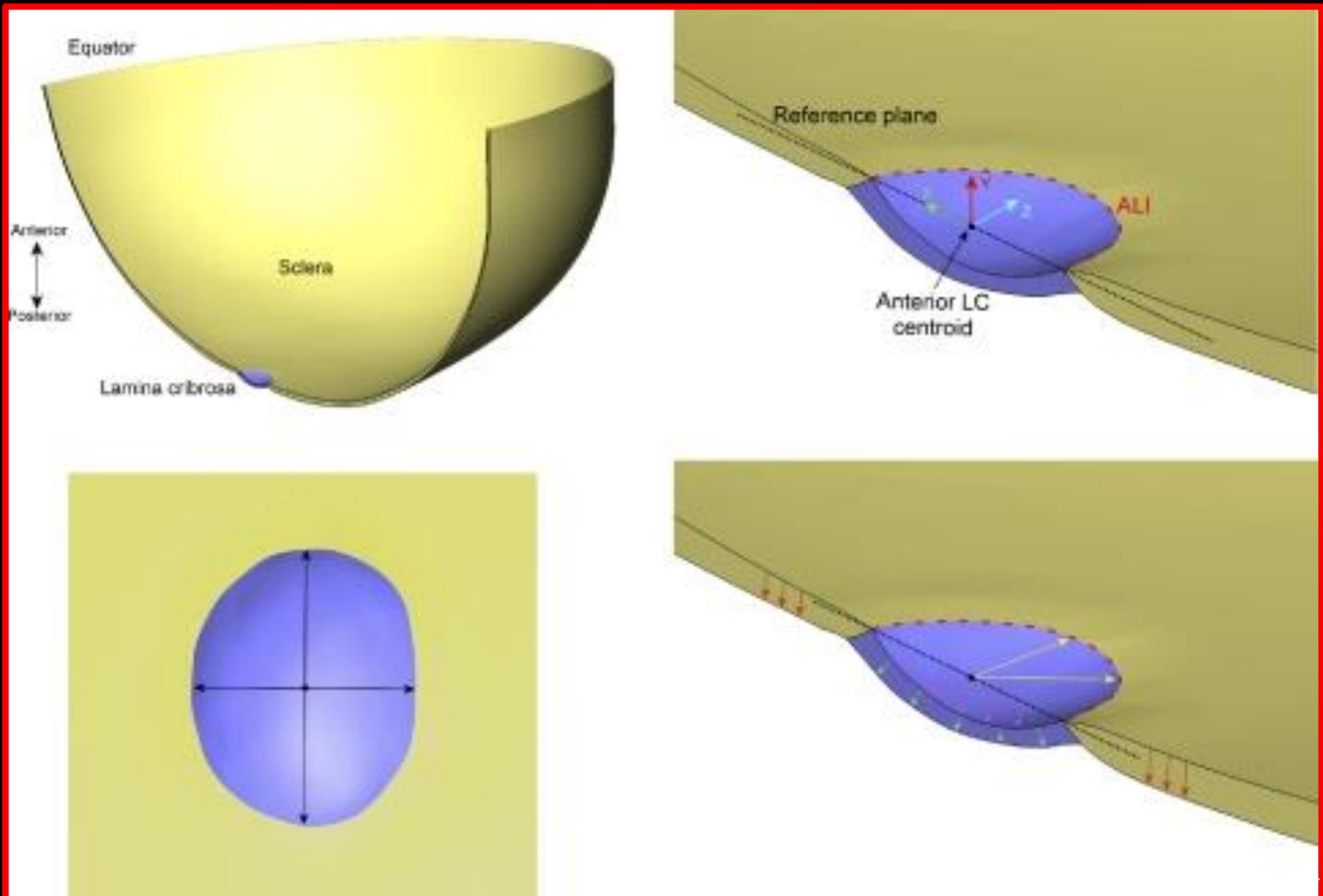
Difetti glaucomatosi (EDI-OCT) della LC di varia forma, profondità e dimensioni, con (B, E, H, K, N e Q frecce rosse) e senza linee di demarcazione (F, I, L, O e R). Il pit acquisito del ONH infero-temporale nella foto (J, M e P), corrisponde al difetto focale in OCT. Le linee tratteggiate con frecce nelle foto indicano i cross-sectional OCT( A, D, G, J, M e P). Le linee continue gialle indicano la superficie anteriore e i difetti focali laminari della LC (B, E, H, K, N e Q) -

***(Saman Kiumehr et al.)***



Immagini ottenute prima (a1, a2) e dopo chirurgia, a 7 gg (b1, b2), 30 gg (c1, c2) e 90 gg (d1, d2). Dopo chirurgia la IOP si è ridotta da 18mmHg a 6mmHg dopo 7 gg, a 13mmHg dopo 30 gg, a 14mmHg dopo 90 gg. La linea orizzontale di riferimento connette i limiti della m. di Bruch; tre linee verticali congiungono la linea di riferimento con la superficie anteriore del Cup (a1,b1,c1) e la superficie anteriore della LC (a2,b2,c2). Lo spessore del tessuto prelaminare (freccia rossa) e il Cup migliorano molto in b1, in modo lieve in b2; lo spessore prelaminare e il Cup decrescono a 30 gg (c1,c2) e a 90 gg (d1,d2) dopo chirurgia – **(C. Barrancos et al.)**

# Modello biomeccanico delle forze operanti sulla sclera e la regione della LC (C. Bourgoin)



*Thanks for  
Your attention*

