Keratoconus

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Introduction

- Onset in adolescence
- Progressive thinning and protrusion of the cornea
- Inflammation likely plays an important role
- Genetic predisposition with environmental triggers
- In SA F>M, due to association with VKC
- Bilateral but asymmetrical
- Arrests in 3-4th decade

Associations

Systemic

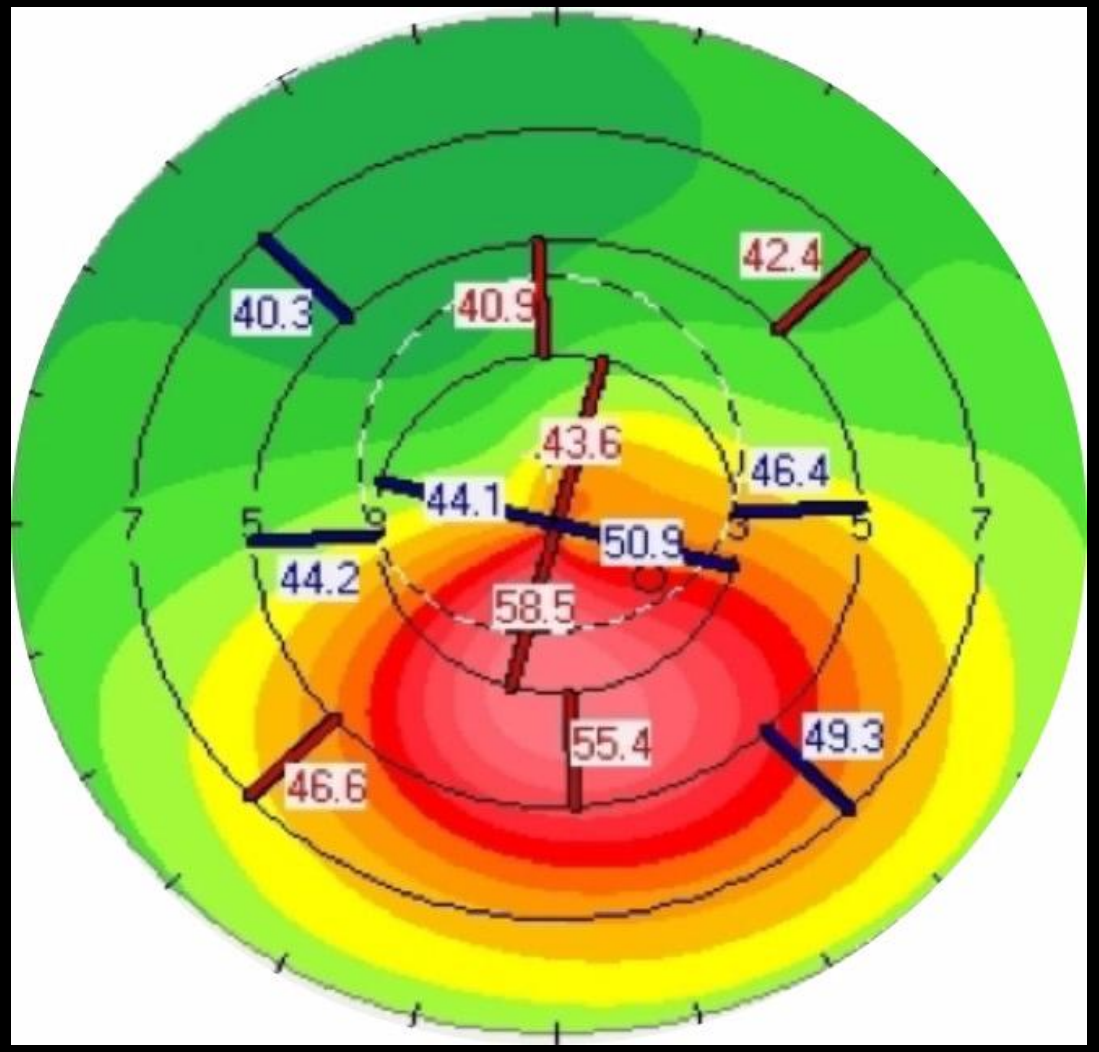
- Atopic disease
- Down’s Syndrome
- CT diseases (Ehlers, Marfans etc)
- Thyroid disease (hyper and hypo)

Ocular

- Retinitis pigmentsa
- Lebers congenital amurosis
- Allergic eye disease
- Dystrophies
  - PPCD
  - FECD
- ROP

Diagnosis

- History
- Clinical
- Tomography
- Epithelial maps
- Biomechanics



Diagnosis: history

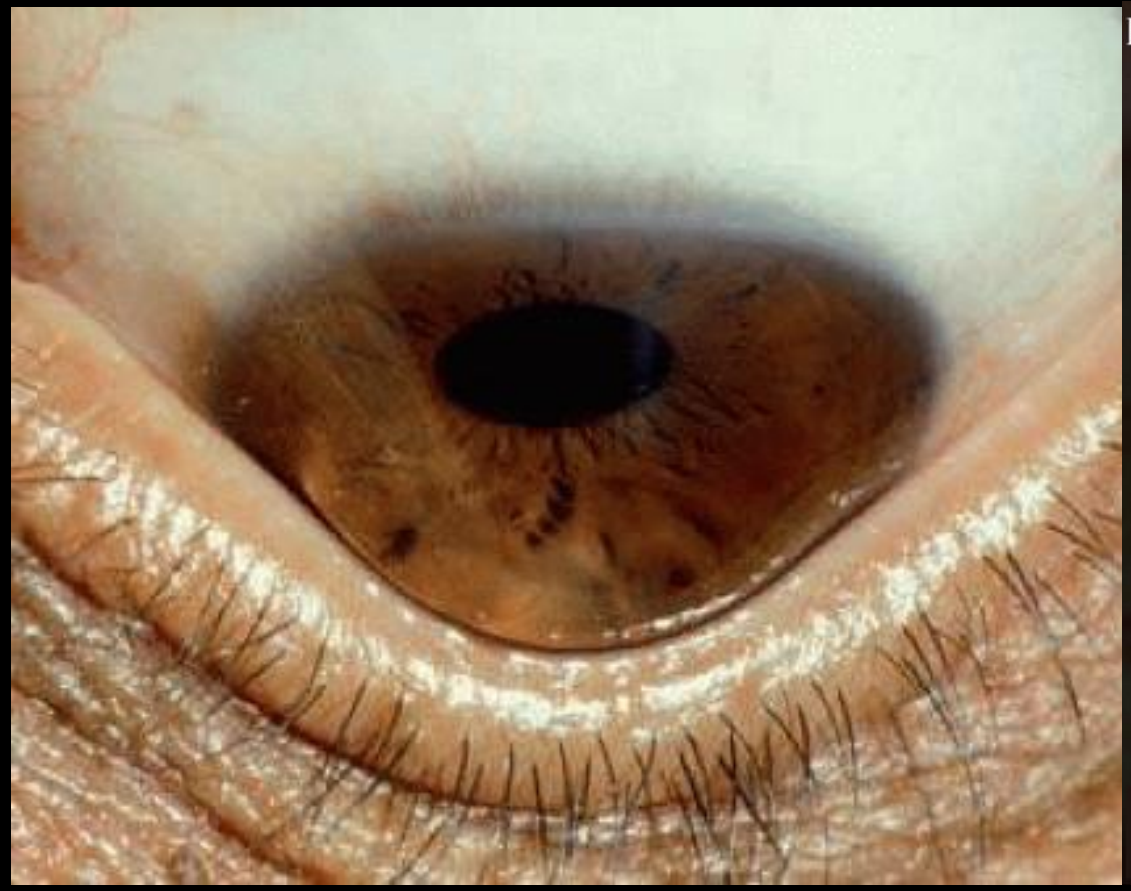
- Teens to 20s
- Unilateral decreasing vision
- Photophobia and glare
- Frequently changing glasses script

Diagnosis: clinical

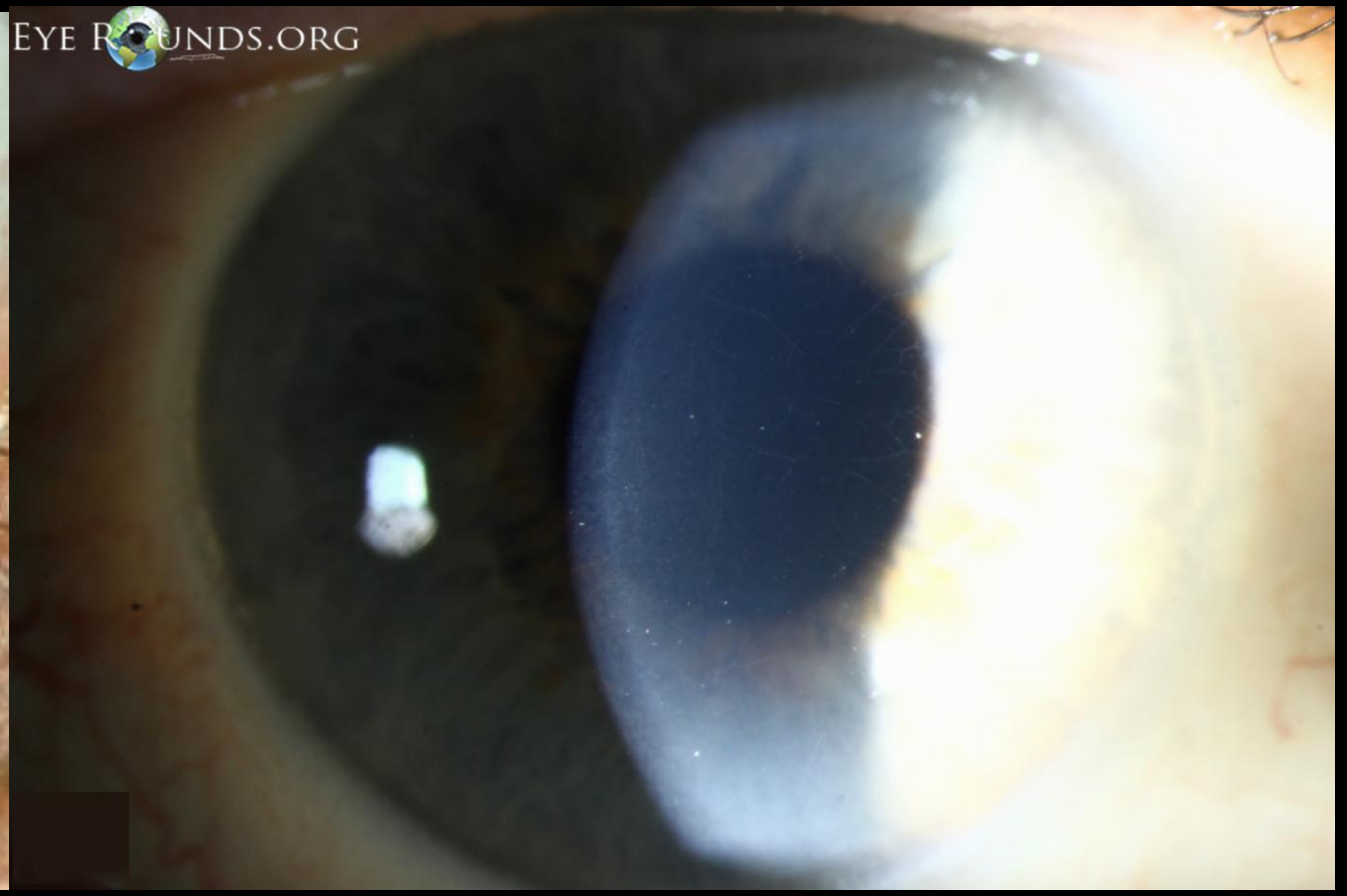
- Refractive error
  - Myopic with irregular astigmatism
  - Typically with inferior steepening
  - HOA, especially coma

Diagnosis: retinoscopy

Diagnosis: clinical



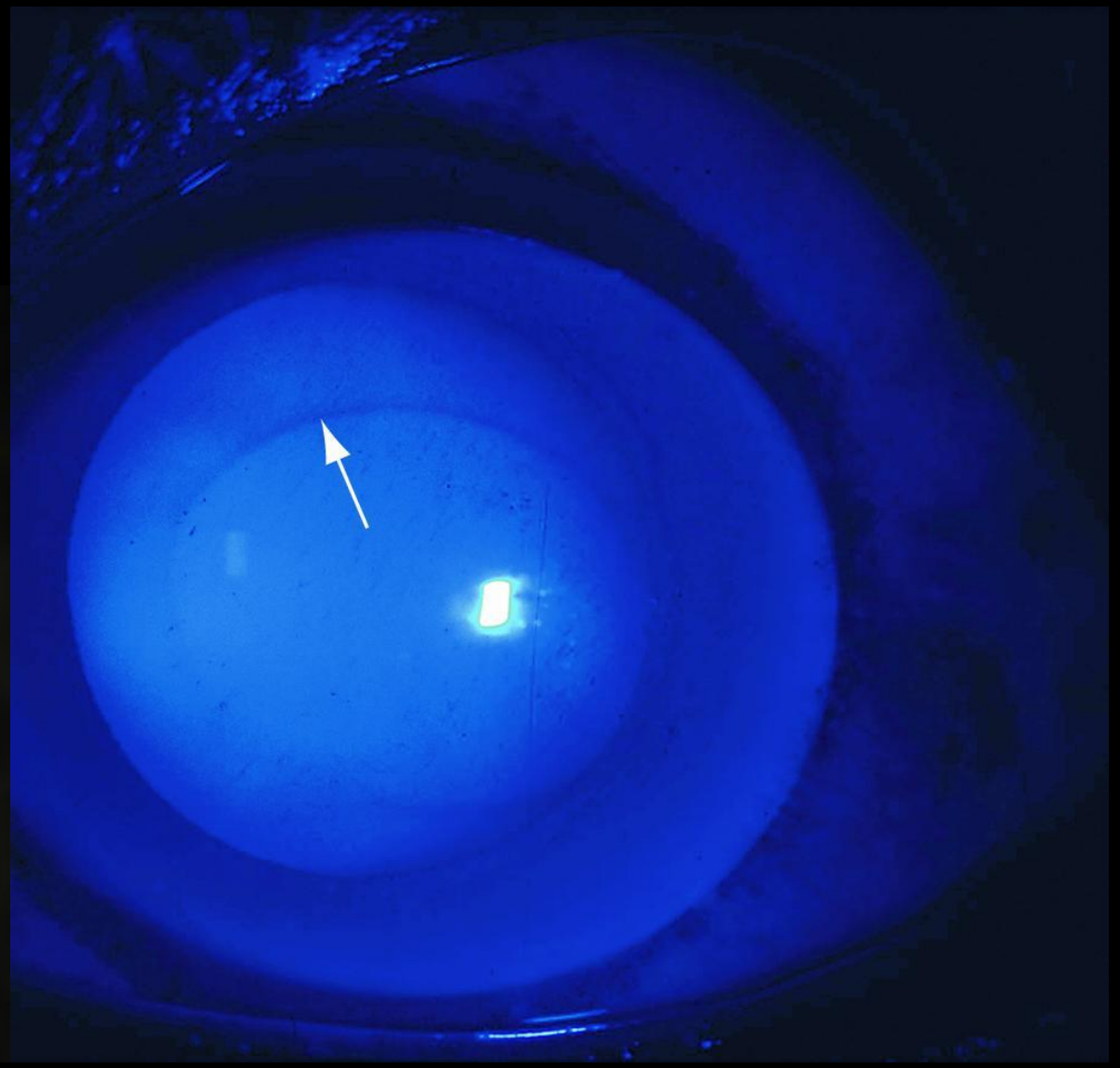
Munson’s Sign



Prominent Corneal Nerves

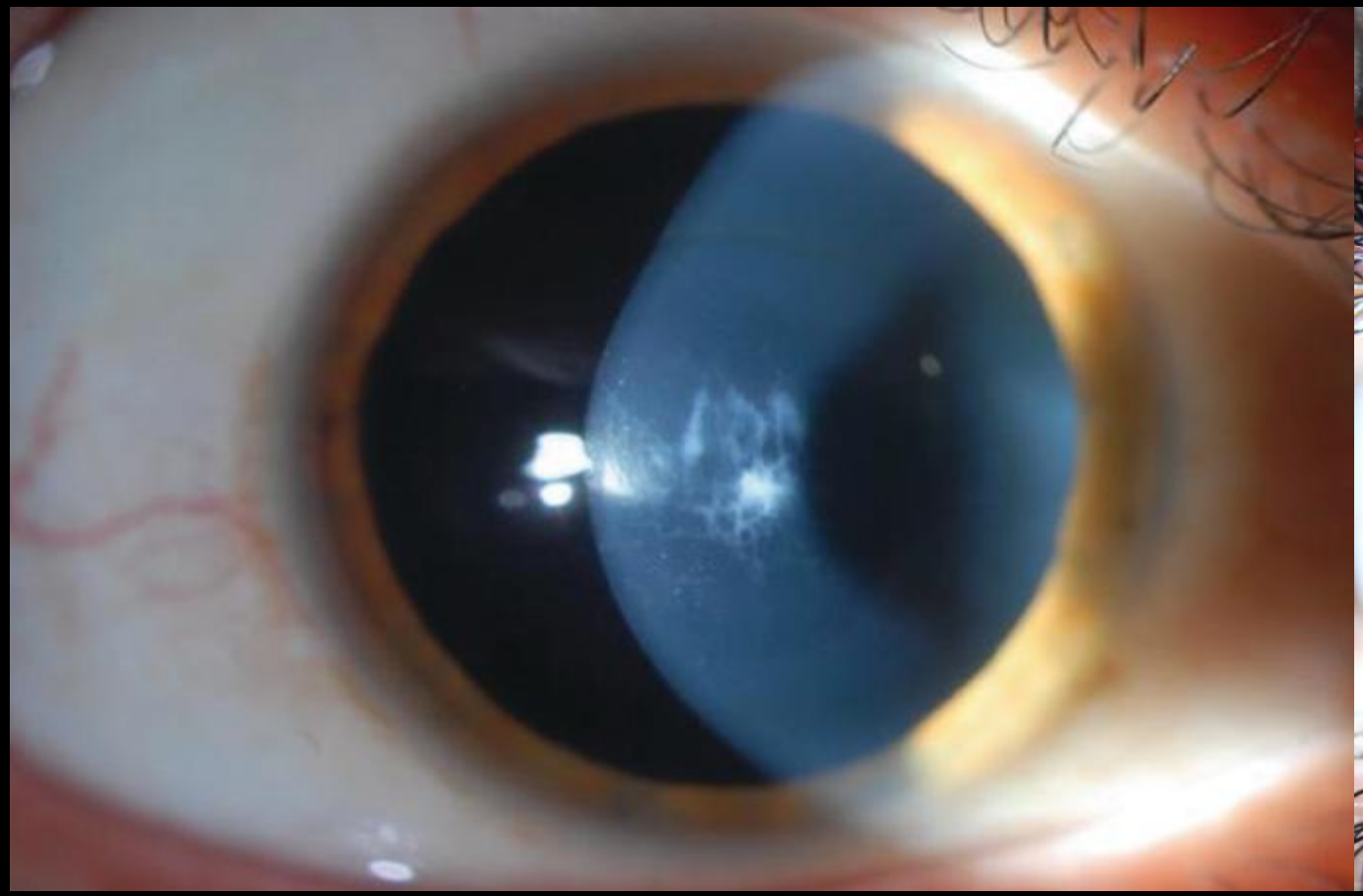
Diagnosis: clinical

Vogt Striae

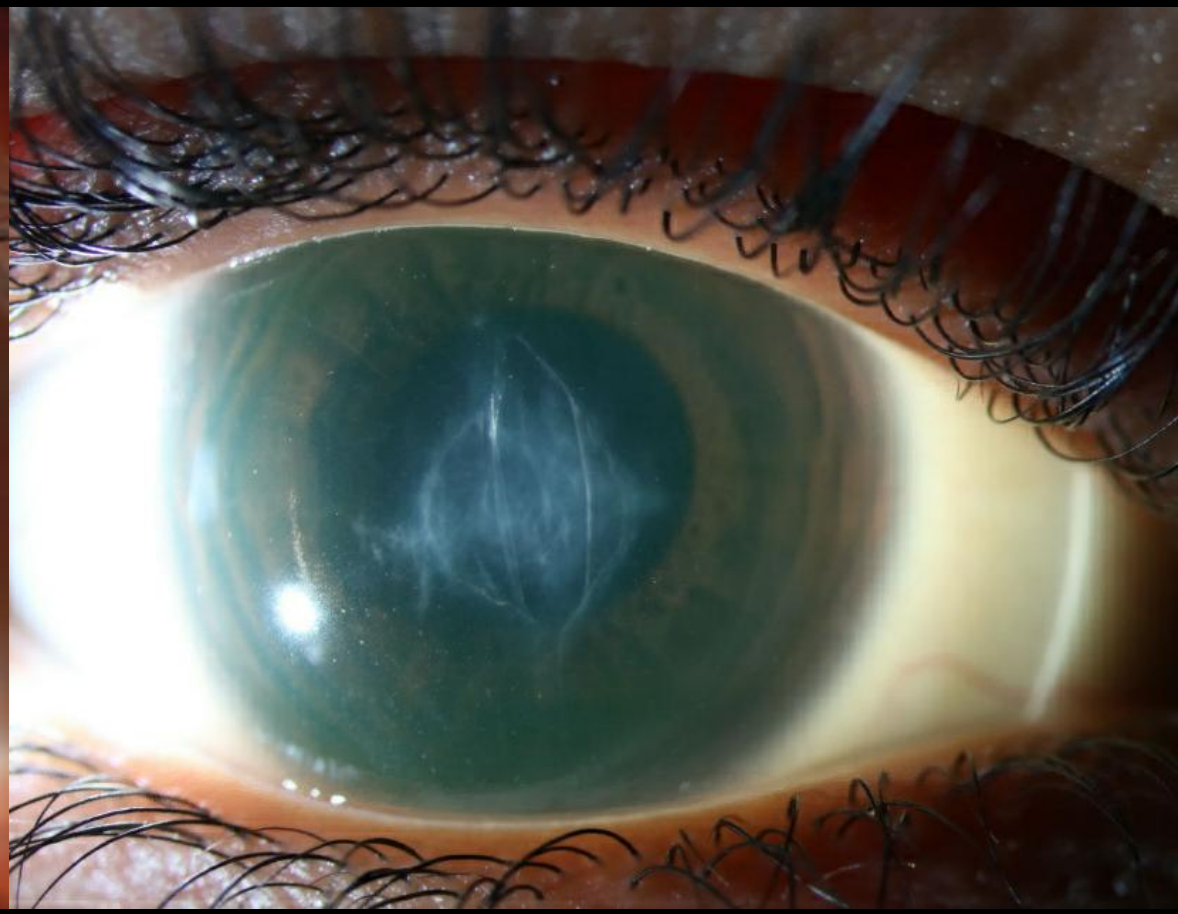


Fleischer Ring

Diagnosis: clinical



Apical Scarring

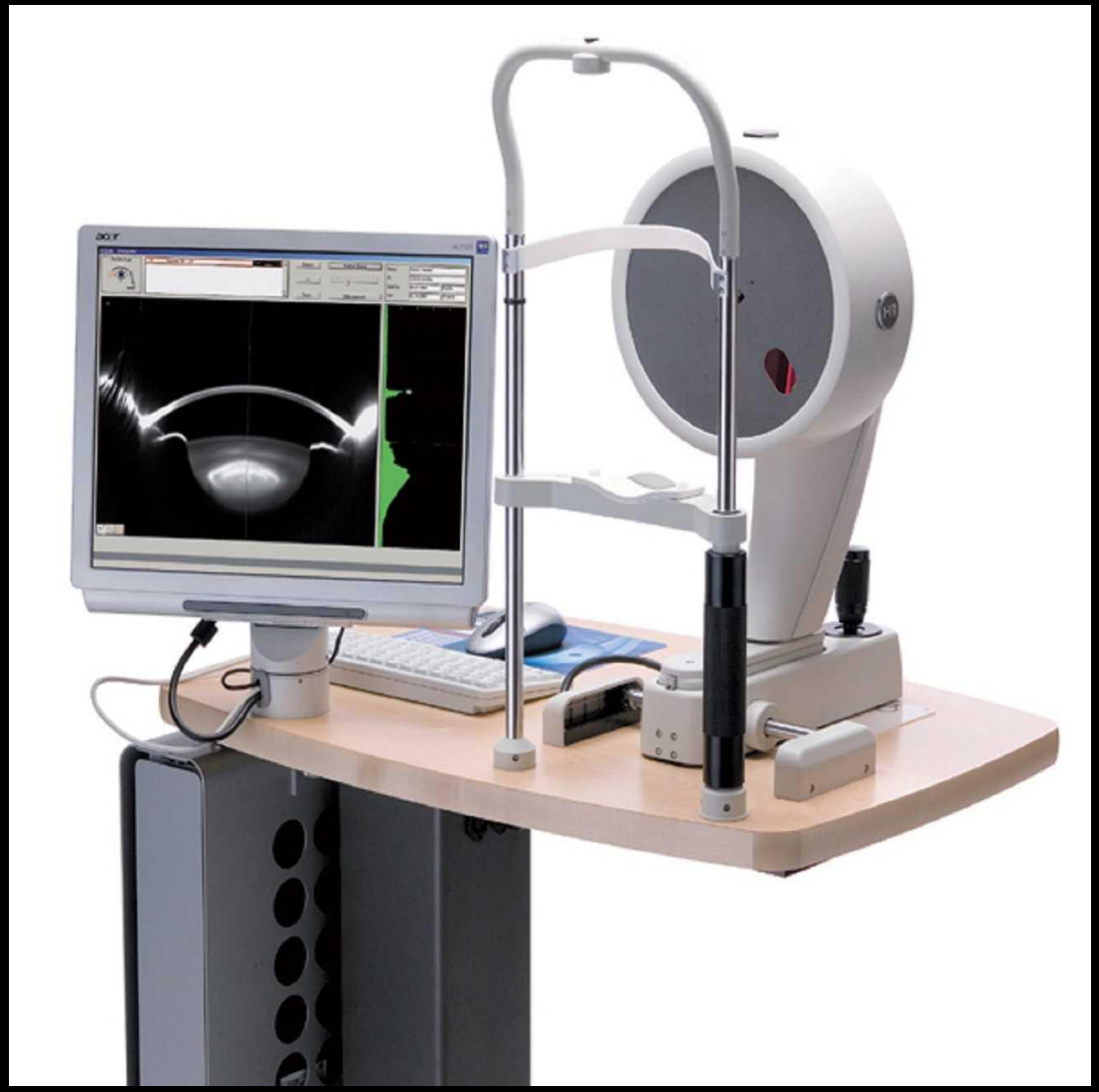


Old Hydrops

Diagnosis: tomography

Characteristics

- High astigmatism
- Asymmetrical bowtie
- Skewed radial axis
- Abnormal elevations
  - Anterior >15
  - Posterior >20
- Abnormal pachymetric progression



Tur, V.M., MacGregor, C., Jayaswal, R., O'Brart, D. and Maycock, N., 2017. A review of keratoconus: diagnosis, pathophysiology, and genetics. Survey of ophthalmology, 62(6), pp.770-783.

OCULUS - PENTACAM 4 Maps Refractive

1.25r15

[redacted]

Cornea Front

Rf:	7.69 mm	K1:	43.9 D
Rs:	7.48 mm	K2:	45.1 D
Rm:	7.58 mm	Km:	44.5 D
QS: OK	Axis: (steep) 73.5 °	Astig:	1.2 D
Q-val.: (8mm) -0.61	Rper: 8.13 mm	Rmin:	6.96 mm

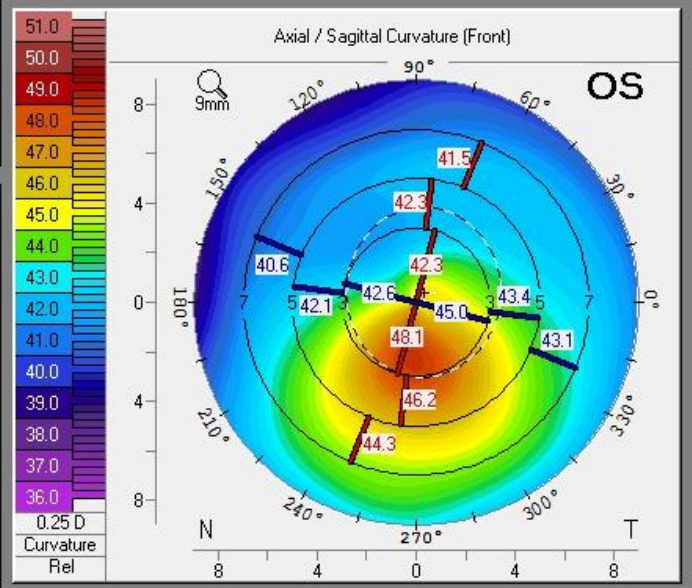
Cornea Back

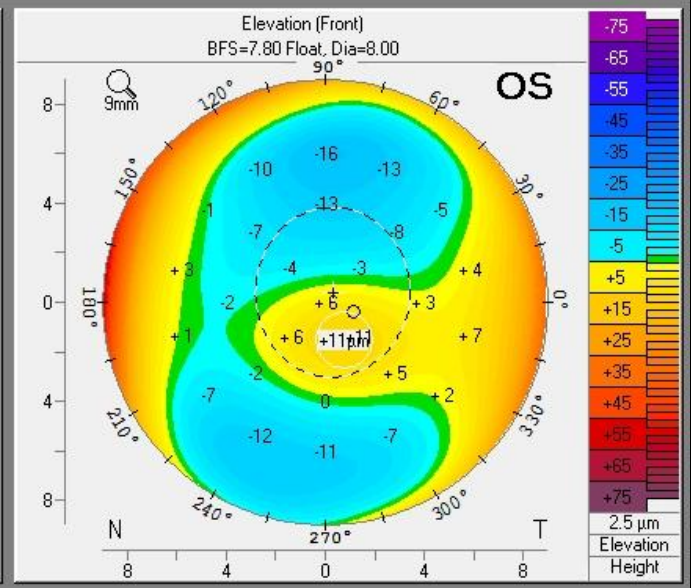
Rf:	6.16 mm	K1:	-6.5 D
Rs:	5.70 mm	K2:	-7.0 D
Rm:	5.93 mm	Km:	-6.7 D
QS: OK	Axis: (steep) 86.2 °	Astig:	0.5 D
Q-val.: (8mm) -0.82	Rper: 6.80 mm	Rmin: ◇	4.89 mm

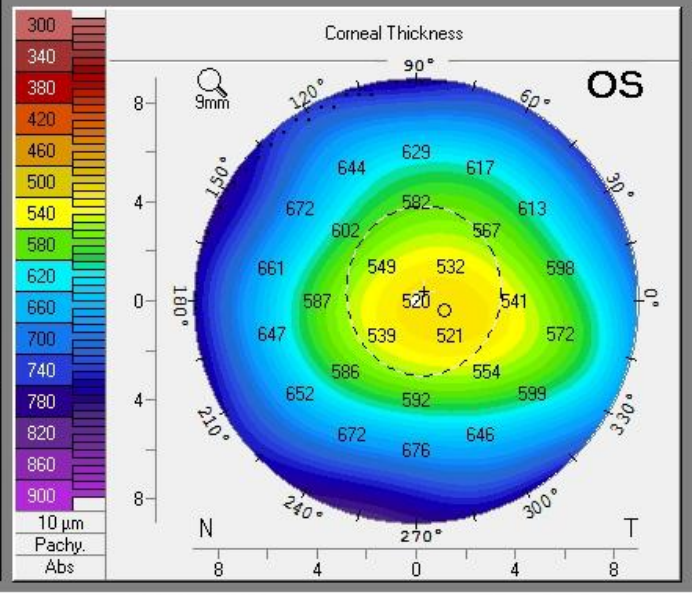
	Pachy:	x[mm]	y[mm]
Pupil Center: +	520 µm	+0.15	+0.20
Pachy Vertex N.: ·	520 µm	0.00	0.00
Thinnest Locat.: ○	515 µm	+0.57	-0.19
K Max. (Front):	48.5 D	0.00	-1.21

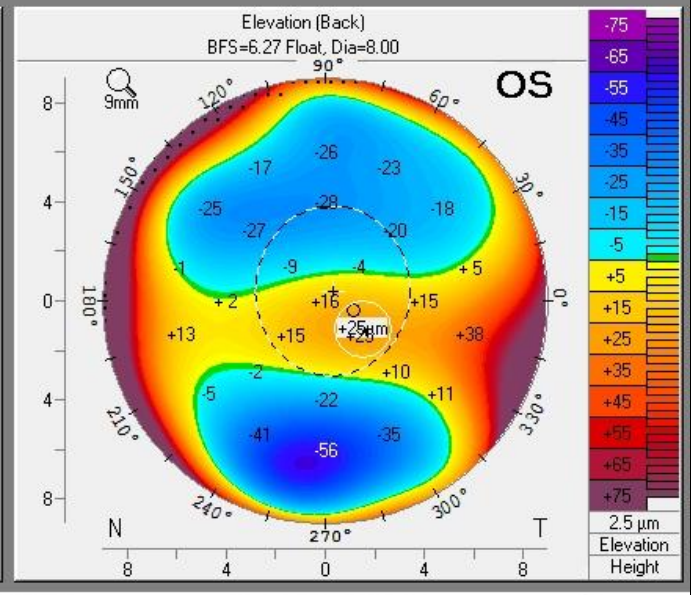
Cornea Volume:	61.0 mm³	HWTW:	11.2 mm
Chamber Volume:	144 mm³	Angle:	36.2 °
A. C. Depth (Int.):	2.83 mm	Pupil Dia:	3.27 mm
Enter IOP / IOP(Sum):	+1.2 mmHg	Lens Th.:	

Refractive









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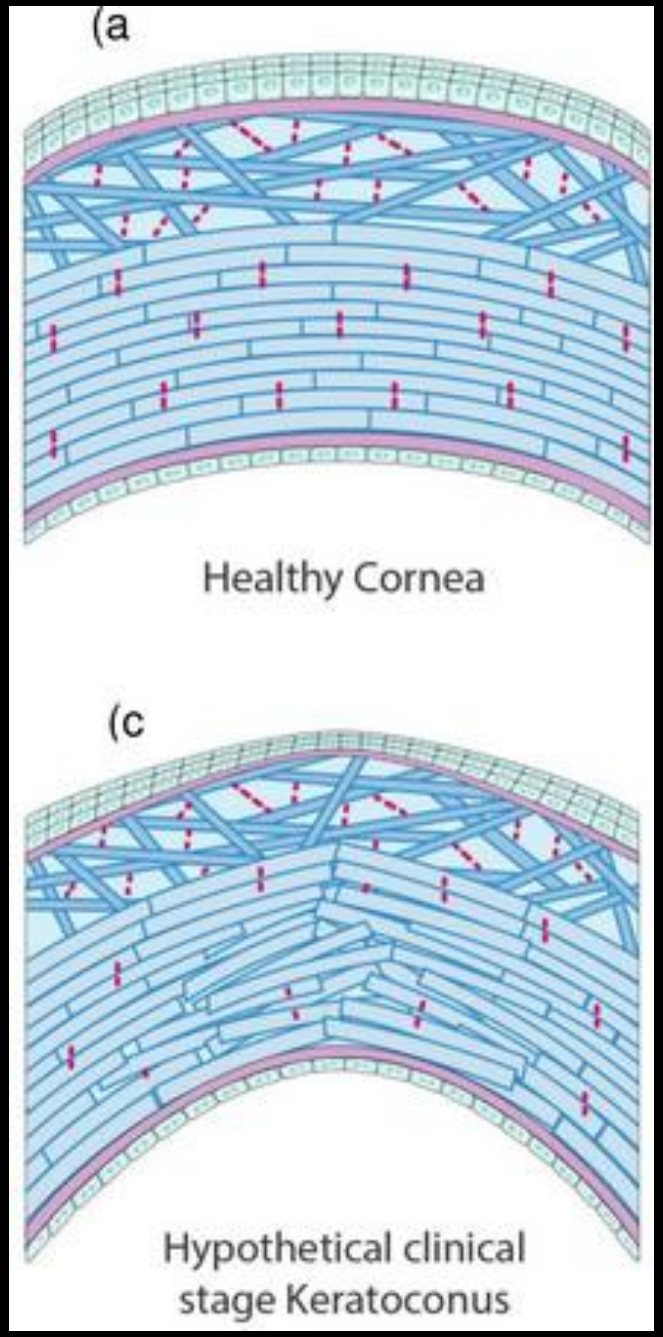
www.oculus.de

OCULUS

Diagnosis: epithelial maps

Characteristics

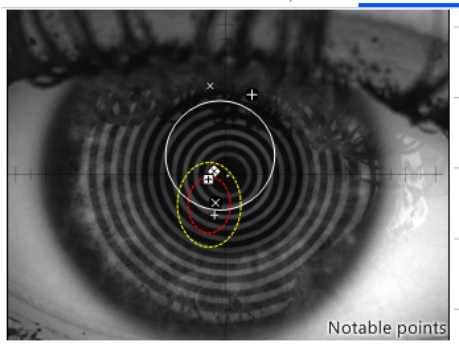
- Epithelial profile is created by the movement of the upper lid over the eye
- Thinnest superior
- Thickest inferior and nasal
- Difference of 15um between thickest and thinnest significant
- Keratoconus has thin island over cone



Reinstein, D.Z., Archer, T.J. and Gobbe, M., 2009. Corneal epithelial thickness profile in the diagnosis of keratoconus. Journal of refractive surgery, 25(7), pp.604-610.

File | Edit | Summary | Sections | 1 map | Keratoconus | Wave-Front | Other | Compare | Subtract | Export | Settings | Favorite | Manual | Information | Fellow eye | Close

OD | OS | Enantiomorphism | **Bilateral summary**



Epi-Thk$_{MIN}$ = 50 µm
Str-Thk$_{MIN}$ = 479 µm
Thk$_{MIN}$ = 530 µm
K^{F}_{MAX} = 44.85 D (7.53 mm)
K^{B}_{MAX} = -10.68 D (3.74 mm)
Δz^{F}_{MAX} = 8.7 µm
Δz^{B}_{MAX} = 93.8 µm

⊕: (-0.39; 0.11) mm
⊞: (-0.58; -0.16) mm
⊕: (-0.58; -0.15) mm
⊗: (-0.34; -0.94) mm
⊕: (0.88; 2.66) mm
⌖: (-0.37; -1.35) mm
⌘: (-0.51; 2.96) mm

NPS = 1.82 mm

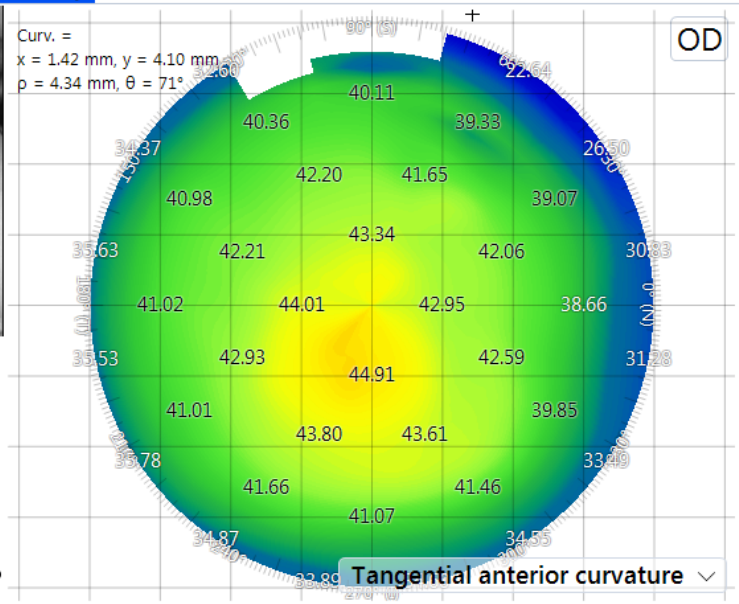
Curvatures:
SI^{F} = 0.97 D
CSI^{F} = 1.08 D
SI^{B} = 0.17 D
CSI^{B} = 0.28 D

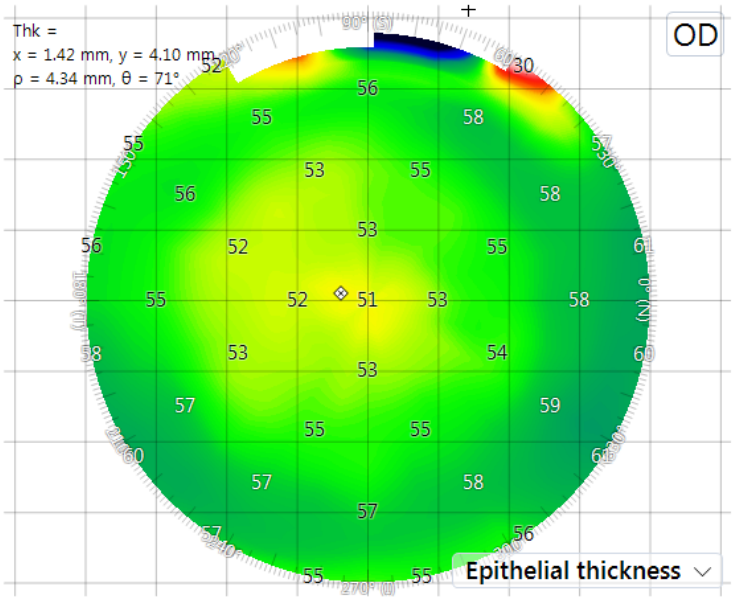
Elevations:
EI^{F} = 8.69 µm @ 255°
EI^{B} = 5.18 µm @ 100°

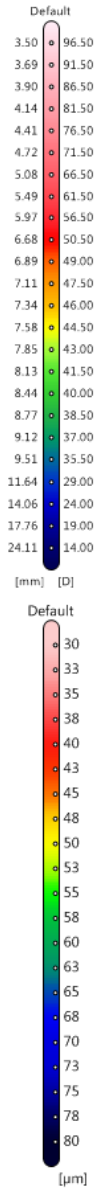
Corneal thickness:
Thk$_{MIN}$ = 530 µm
TSI = 9.06 µm
TI$_{MAX}$ = -0.01

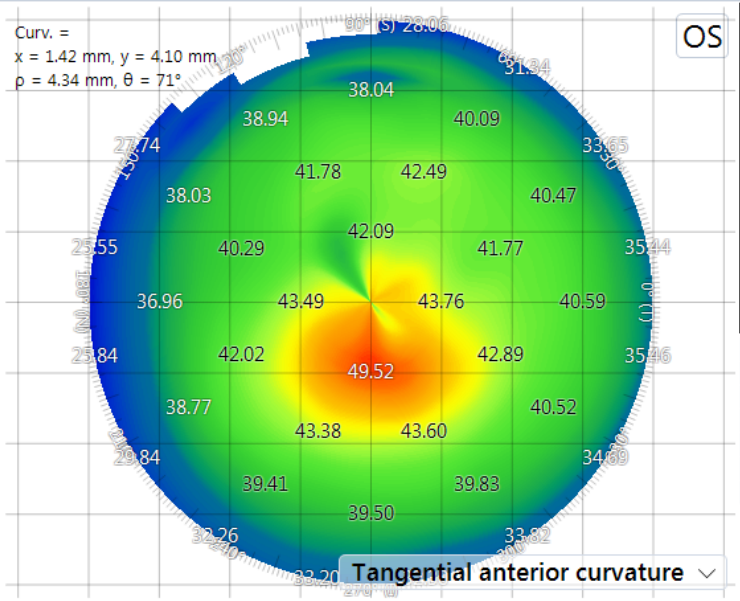
Epithelial thickness:
Epi-TI = 13.07

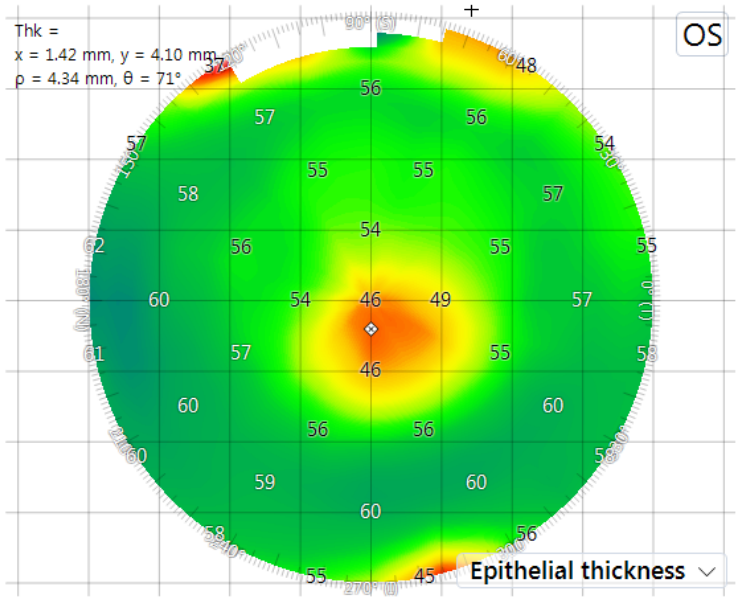
Classification: Other

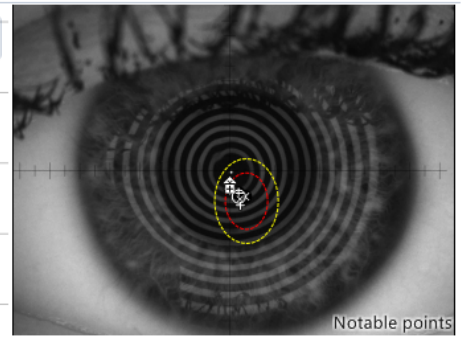












Epi-Thk$_{MIN}$ = 44 µm
Str-Thk$_{MIN}$ = 463 µm
Thk$_{MIN}$ = 508 µm
K^{F}_{MAX} = 48.08 D (7.02 mm)
K^{B}_{MAX} = -8.74 D (4.57 mm)
Δz^{F}_{MAX} = 13.1 µm
Δz^{B}_{MAX} = 38.1 µm

⊕: (0.00; -0.40) mm
⊞: (0.00; -0.60) mm
⊕: (0.00; -0.60) mm
⊗: (0.51; -0.86) mm
⊕: (0.29; -0.75) mm
⌖: (0.35; -1.15) mm
⌘: (0.34; -0.94) mm

NPS = 0.22 mm

Curvatures:
SI^{F} = 2.47 D
CSI^{F} = 1.95 D
SI^{B} = 0.85 D
CSI^{B} = 0.66 D

Elevations:
EI^{F} = 13.11 µm @ 287°
EI^{B} = 38.06 µm @ 290°

Corneal thickness:
Thk$_{MIN}$ = 508 µm
TSI = 24.94 µm
TI$_{MAX}$ = 4.68

Epithelial thickness:
Epi-TI = 31.90

Classification: Keratoconus

Keratoconus morphology:
- Grading (ABCD): A0 B2 C0 D*
- JF Alfonso Phenotype: Duck

Keratoconus center: (0.30; -0.86) mm
Keratoconus axis: 289°
K_{FLAT} @ 168°
K_{STEEP} @ 258°

Diagnosis: biomechanics

Characteristics

- Uses an air puff to measure biomechanical properties
- Corneal biomechanical index
  - >0.5, identifies 98.2% KC
  - 94% sensitivity, 100% specificity
- Total biomechanical index V2
  - <0.29 is normal
  - >0.79, 100% sensitivity and specificity
- Total biomechanical index V3
  - Low risk <0.35
  - Moderate risk 0.35 – 0.75
  - High risk >0.75

Vinciguerra, R., Ambrósio Jr, R., Elsheikh, A., Roberts, C.J., Lopes, B., Morenghi, E., Azzolini, C. and Vinciguerra, P., 2016. Detection of keratoconus with a new biomechanical index. Journal of refractive surgery, 32(12), pp.803-810.

Ambrósio Jr, R., Lopes, B.T., Faria-Correia, F., Salomão, M.Q., Bühren, J., Roberts, C.J., Elsheikh, A., Vinciguerra, R. and Vinciguerra, P., 2017. Integration of Scheimpflug-based corneal tomography and biomechanical assessments for enhancing ectasia detection. Journal of Refractive Surgery, 33(7), pp.434-443.

Management

Management: Risks

- Allergic eye disease
  - Anti-histamines
  - Mast cell stabilisers
  - Steroids/cyclosporine/tacrolimus
- Lubricants
  - Reduces inflammatory and allergic agents
- Eye rubbing
  - Most important

Management: Progression

Progression is defined as a change in 2 of these 3 parameters:

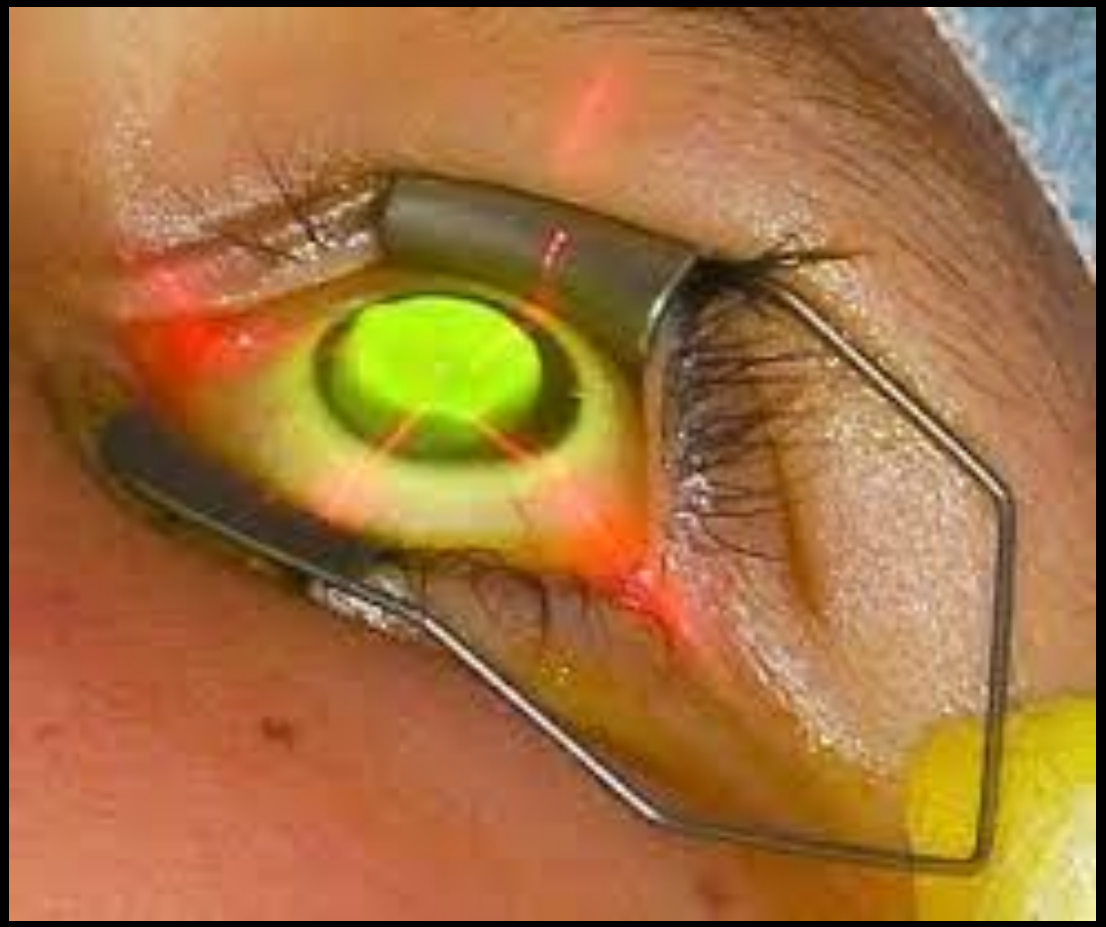
- Steepening of the anterior surface
- Steepening of the posterior surface
- Corneal thinning

Kmax has been used in the past, but is a poor measure of progression

Gomes, J.A., Tan, D., Rapuano, C.J., Belin, M.W., Ambrósio Jr, R., Guell, J.L., Malecaze, F., Nishida, K. and Sangwan, V.S., 2015. Global consensus on keratoconus and ectatic diseases. Cornea, 34(4), pp.359-369.

Management: Collagen cross linking

- Increases the strength of the cornea by increasing the covalent bonds within the collagen
- Not aimed at improving vision
- Traditionally need to have >400um corneal thickness
- New protocols for thinner corneas
- Monitor for progression after 1 year



Wollensak, G., Spoerl, E. and Seiler, T., 2003. Riboflavin/ultraviolet-A–induced collagen crosslinking for the treatment of keratoconus. American journal of ophthalmology, 135(5), pp.620-627.

Management: Vision

Stepwise approach

- Spectacles
- Soft contact lenses
- Hard contact lenses
- Corneal ring segments
  - Kerarings/Intacs/Ferrara rings
  - Corneal allograft intrastromal rings segments
- Corneal transplant

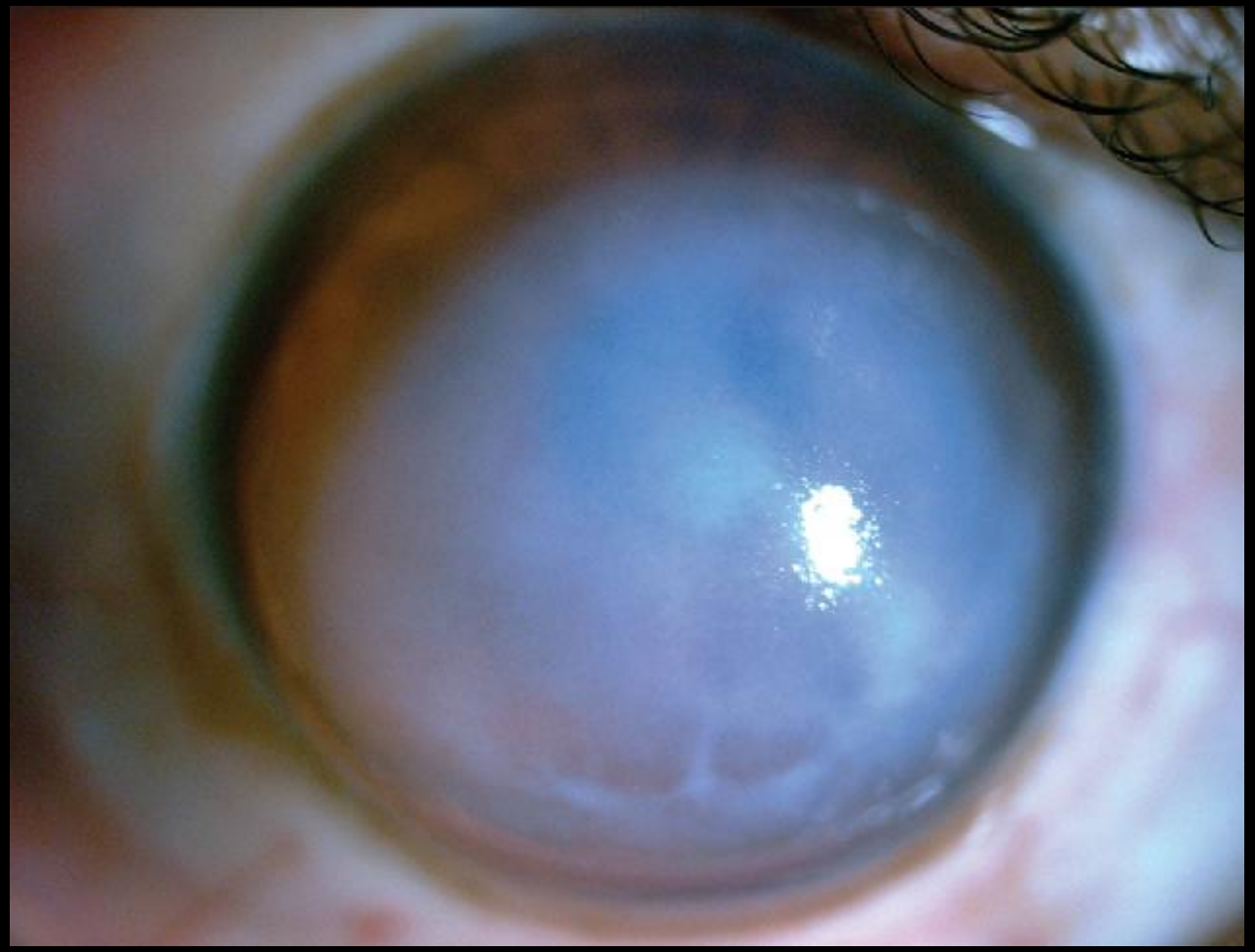
Corneal Hydrops

Pathogenesis

- Break in descemets membrane
- Abnormal stroma

Management

- Hypertonic saline
- Aqueous suppressant
- Topical steroid
- Topical anti-biotic
- Other: gas, sutures, PK



Thank you