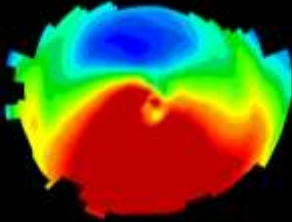


POST LASIK ECTASIA Risk Factors & Screening



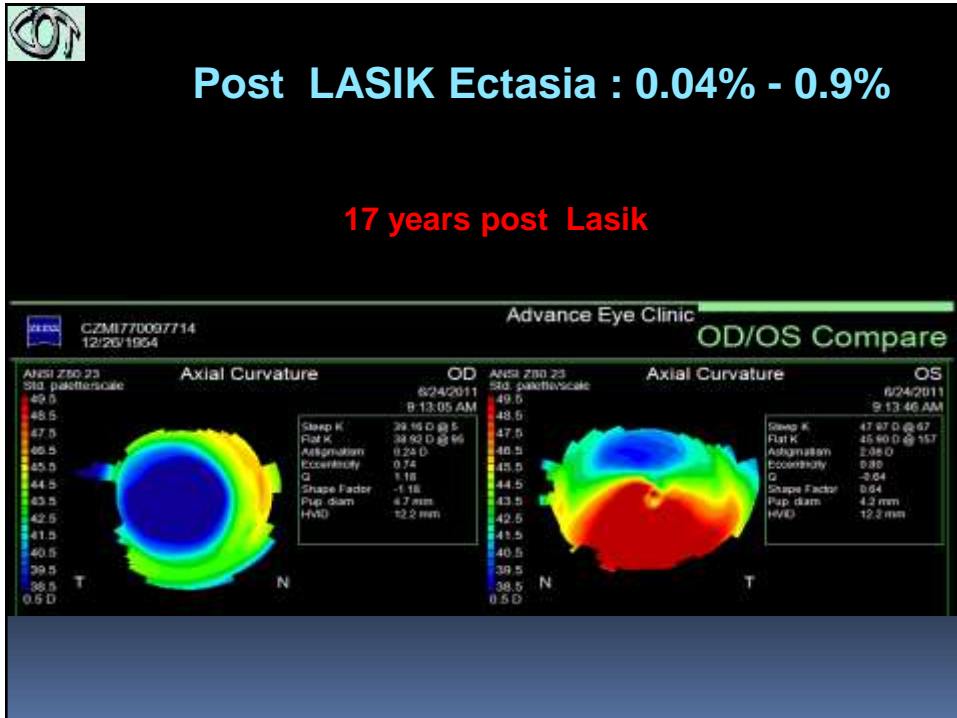
S. MAHJOUB, K. BEN AMOR ,A. BEN SAID,
K. MGAETH, O. TRABELSI, B. BOUASSIDA & A. TRABELSI
Les Ophthalmologistes Associés de Tunis
NADIAL BASSAR
Clinique Ophthalmologique de Tunis
(ISO 9002)

CAIRO'2018



Post LASIK Ectasia

- Epidemiology : rare , unilateral & very late



Post LASIK Ectasia

- Epidemiology : rare , unilateral & very late
- **SMILE & LASIK EXTRA : not protective**

Ectasia following small-incision lenticule extraction (SMILE). Moshirfar et al . Clin Ophthalmol. 2017

Corneal Ectasia After LASIK Combined With Corneal Cross-linking Taneri et al, J Refract Surg. 2017

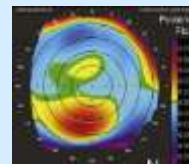


Post LASIK Ectasia

- Epidemiology : rare , unilateral & very late
- SMILE & LASIK EXTRA : not protective
- Tunisia Ectasia Study



ENQUETE NATIONALE SUR LES FACTEURS DE RISQUE DE L'ECTASIE CORNEENNE POST-LASIK



K.Errais, M.BenSalem, F.Nouira, B Grissa, M. Belajouza, S.Mahjoub, H Kamoun

Randleman Score

Table 1. Ectasia Risk Factor Scoring System

Score	0	1	2	3	4
Topography Pattern	Normal/symmetrical bowlie	Asymmetric bowlie		Inferior steepening/skewed radial axis	Form trusts/keratoconus
Residual Stromal Bed Thickness (μm)	>300	280-299	260-279	240-259	<240
Age	>30	26-29	22-25	18-21	
Preop Corneal Thickness (μm)	>510		481-510	451-480	<450
Preop Spherical Equivalent Manifest Refraction (D)	-6 or less	>-8 to -10	>-10 to -12	>-12 to -14	>-14

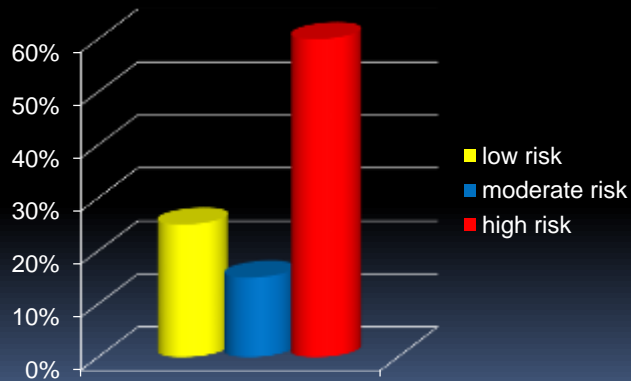
Cumulative Risk Scale Score	Risk Category	Recommendations	Comments
0 to 2	Low risk	Proceed with LASIK or surface ablation	
3	Moderate risk	Proceed with caution, consider special informed consent; safety of surface ablation has not been established	Consider MRSE stability, degree of astigmatism, between-eye topographic asymmetry, and family history
4 or more	High risk	Do not perform LASIK; safety of surface ablation has not been established	

Randleman Score Validity

- High Score : 50-92% ectasia
- Low Score : 6-50% ectasia

Tunisia Ectasia Study

- **Low Randleman score : 25 %**



Randleman Score Validity

- High Score : 50-92% ectasia
- Low Score : : 6-50% ectasia
- **Non independant & non weighted factors**



Pachymetry

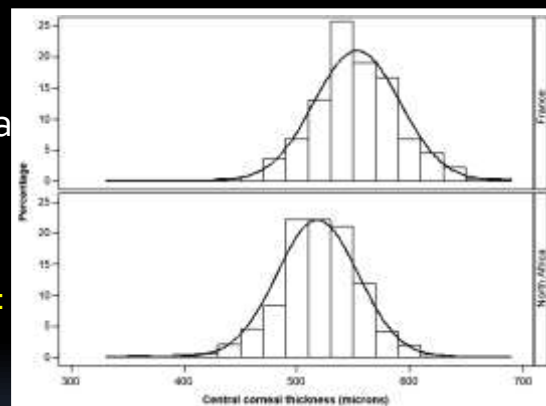
- Non Independent : litterature (450-500 μ)

Long-term observation and evaluation of femtosecond laser-assisted thin-flap laser in situ keratomileusis in eyes with thin corneas but normal topography.
[Tomita et al.](#) J Cataract Refract Surg. 2014



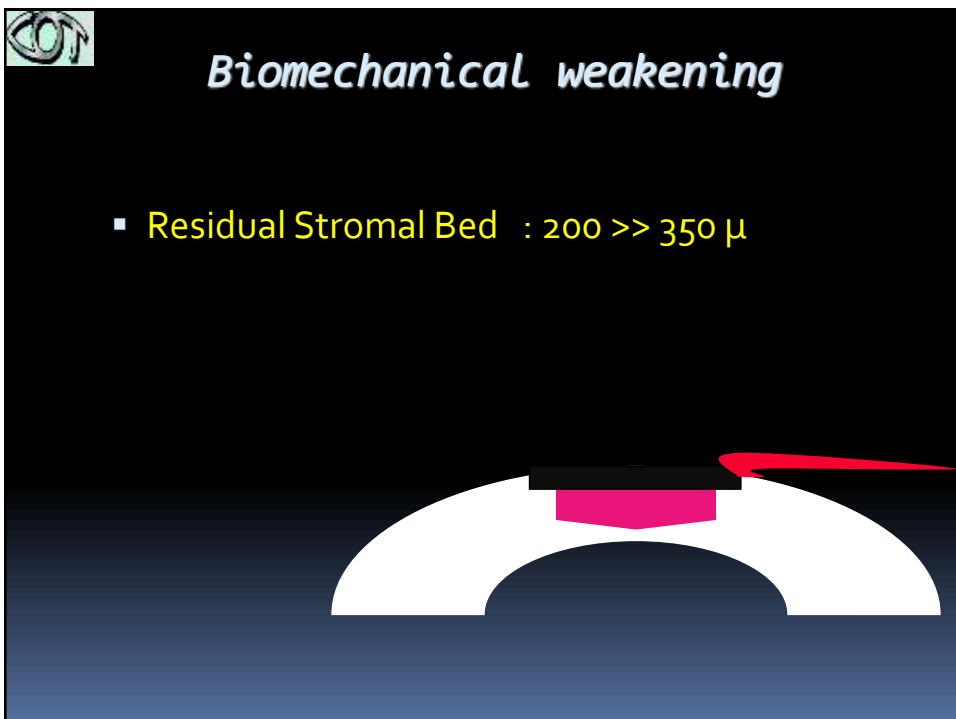
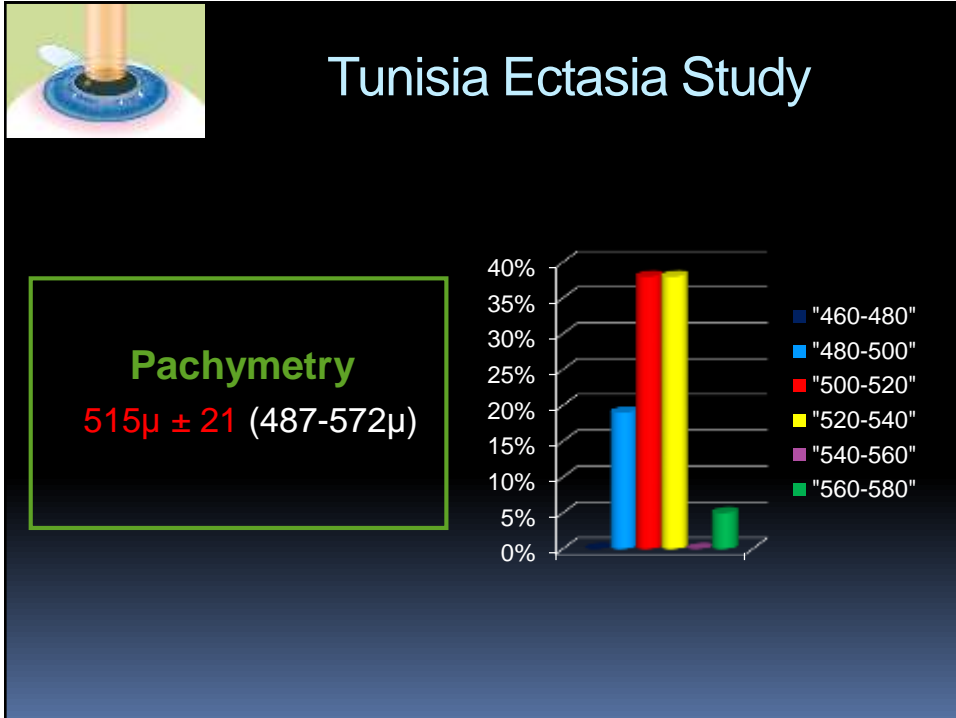
Pachymetry

- Non Independent
- Epidemiology :



Comparison of corneal thickness and biomechanical properties between North African and French patients.

Lazreg et Al. J Cat Refr Surg 2013





Biomechanical weakening

- Residual Stromal Bed : 200 >> 350 μ
- Percent Tissue Altered : < 40 %



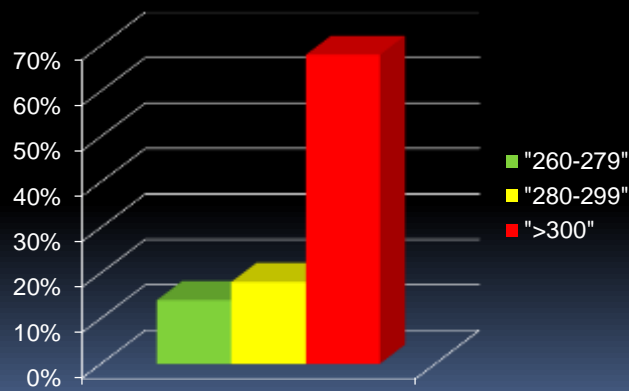
Association between the percent tissue altered and post-laser in situ Keratomileusis ectasia in eyes with normal preoperative topography. [Santhiago et al. Am J Ophthalmol. 2014](#)

Evaluation of the percentage tissue altered as a risk factor for developing post-laser in situ keratomileusis ectasia. [Saad et al J Cataract Refract Surg 2017](#)



Residual Stromal Bed

R.S.B. : 310 μ \pm 24 (273-350)



Abnormal Topography

- Major & Independent factor : 49-90% ectasia



Topographie

- Critères qualitatifs: 85% forme suspecte
- Critères quantitatifs:
 - I-S > 1,4 : 15%
 - SRAX:> 20°: 23,5%

Abnormal Topography

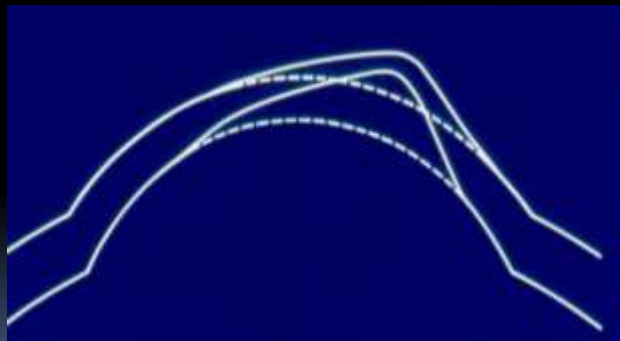
- Major & Independent factor : 49-90% ectasia
- Abnormal topography : 5.7 % ectasia
- Normal topography : 0.05 % ectasia

Rate of ectasia and incidence of irregular topography in patients with unidentified preoperative risk factors undergoing femtosecond laser-assisted LASIK. Moshirfar & Al. Clin Ophthalmol. 2014



KERATOCONUS

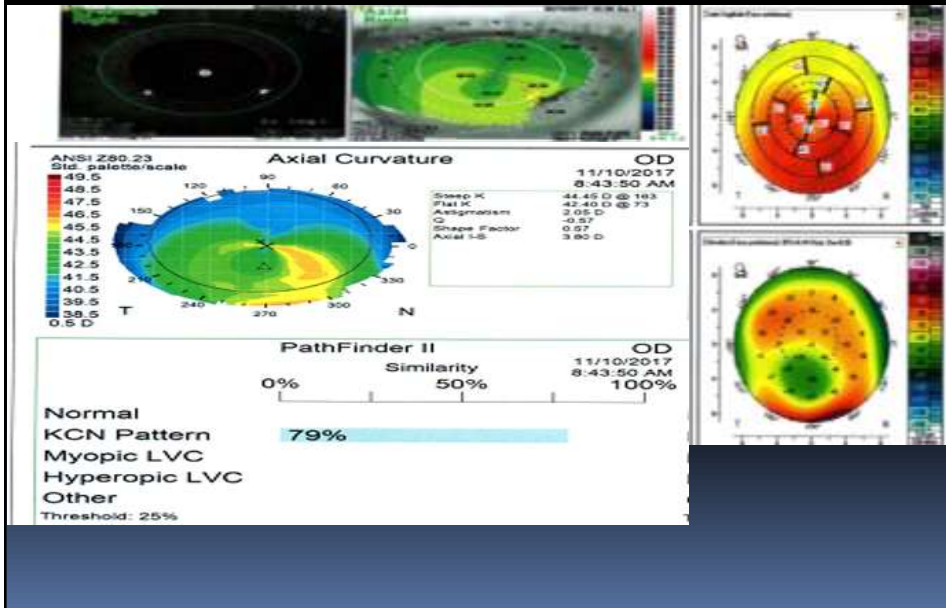
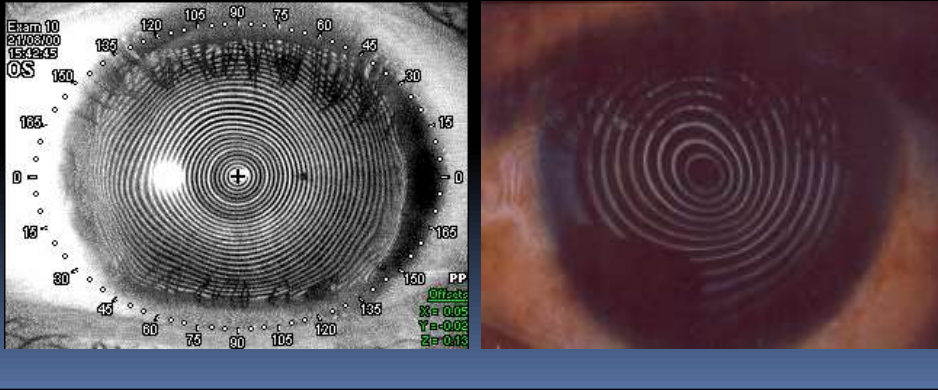
- ◆ Cornea morphology : no bio marker





KERATOCONUS

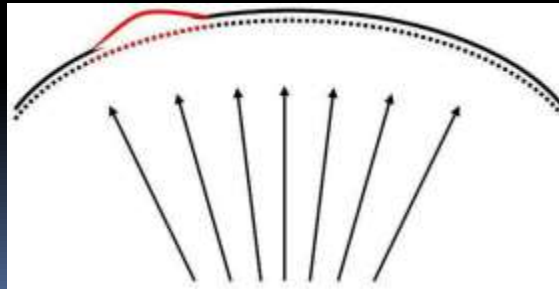
- ◆ Cornea morphology : no bio marker
- ◆ Topography : spatial resolution 20-60 X



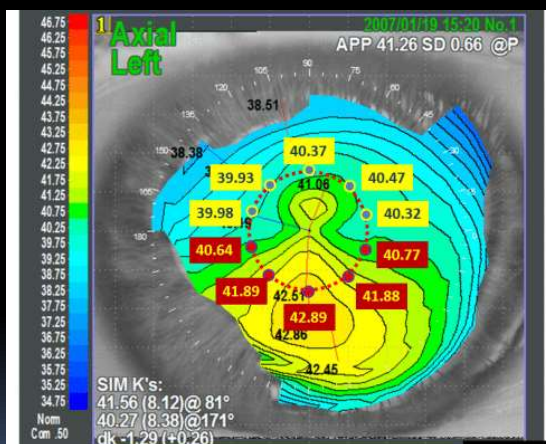


KERATOCONUS

- ◆ Cornea morphology : no bio marker
- ◆ Topography : spatial resolution 20-40 X
- ◆ Assymetry : I-S index



I-S Index (Rabinovitz)



Computer-assisted corneal topography in family members of patients with keratoconus. [Rabinowitz et Al Arch Ophthalmol. 1990](#)

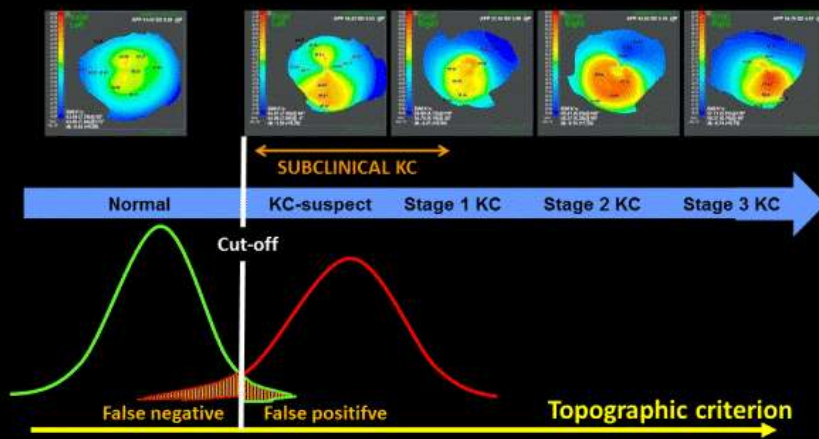


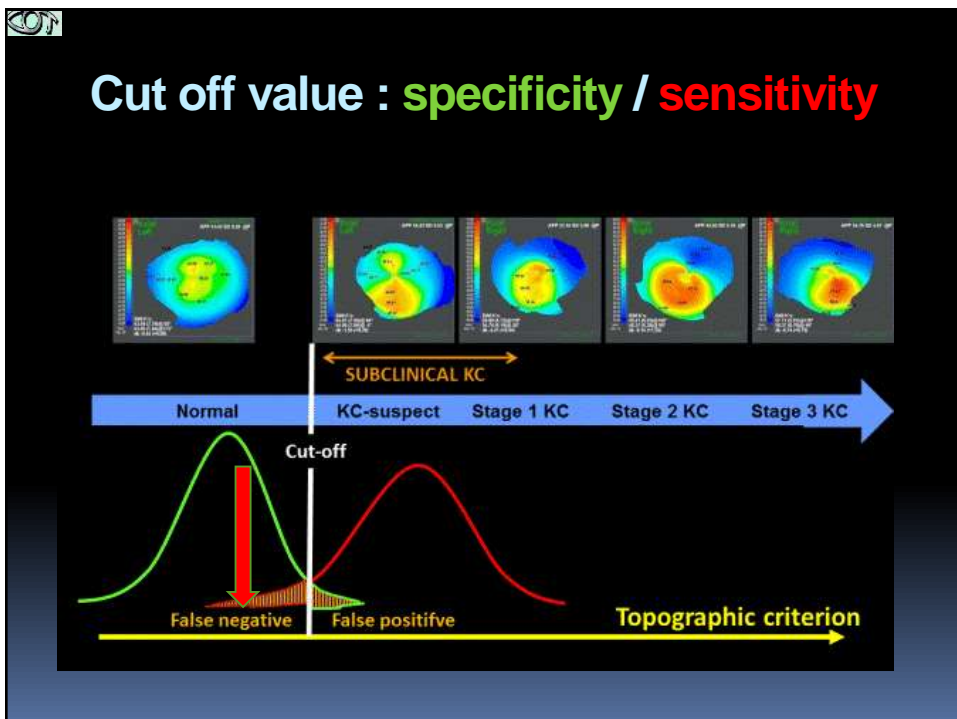
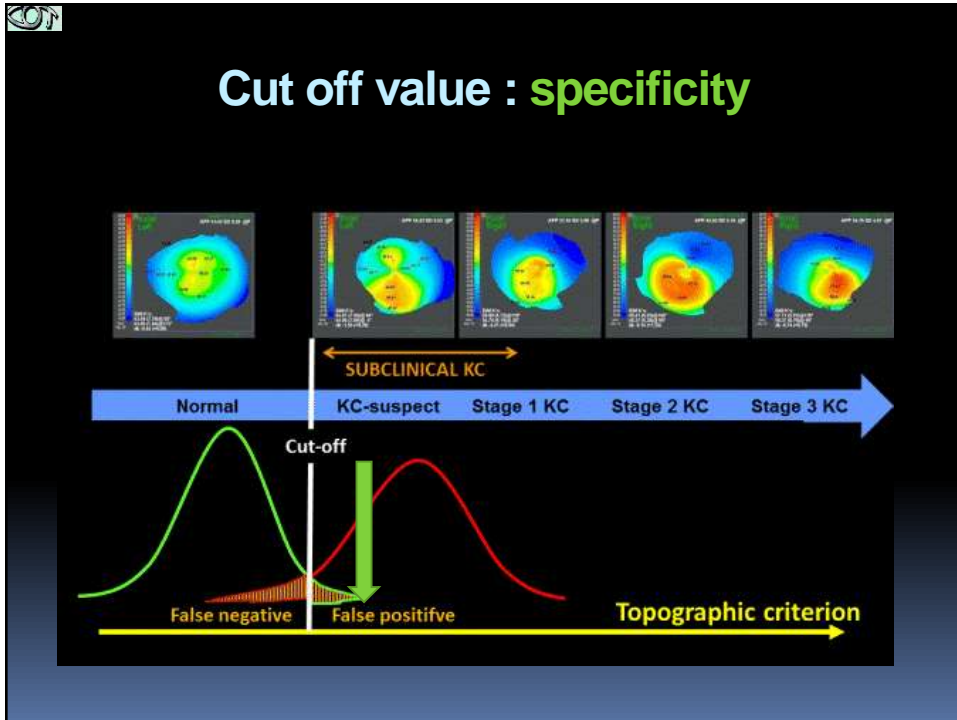
KERATOCONUS

- ◆ Cornea morphology : no bio marker
- ◆ Topography : spatial resolution 20-40 X
- ◆ Assymetry : I-S index
- ◆ **Cut off value : sensitivity**



Cut off value

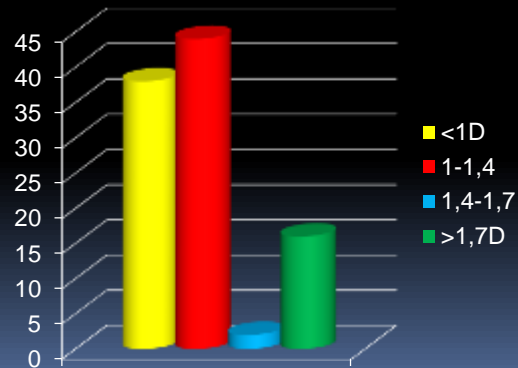






I-S INDEX

score I-S > 1 (65 %)



KERATOCONUS

- ◆ Cornea morphology : no bio marker
- ◆ Topography : spatial resolution 20-40 X
- ◆ Assymetry : I-S index
- ◆ Cut off value : sensitivity
- ◆ **Composite index : automated detection**

Automated keratoconus screening with corneal topography analysis.
 Maeda N¹, Klyce SD, Smolek MK, Thompson HW. Invest Ophthalmol Vis Sci. 1994

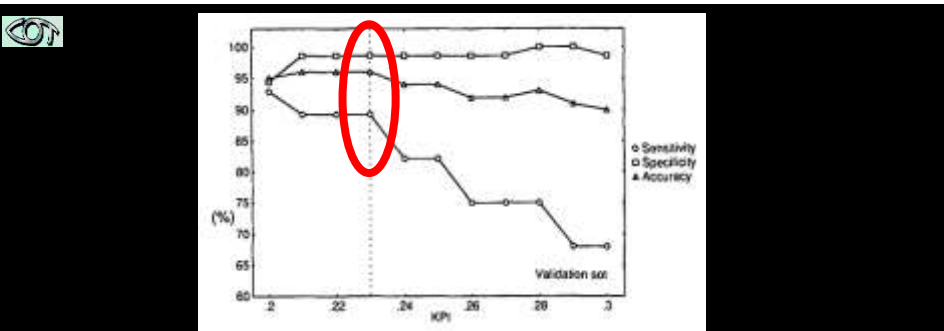
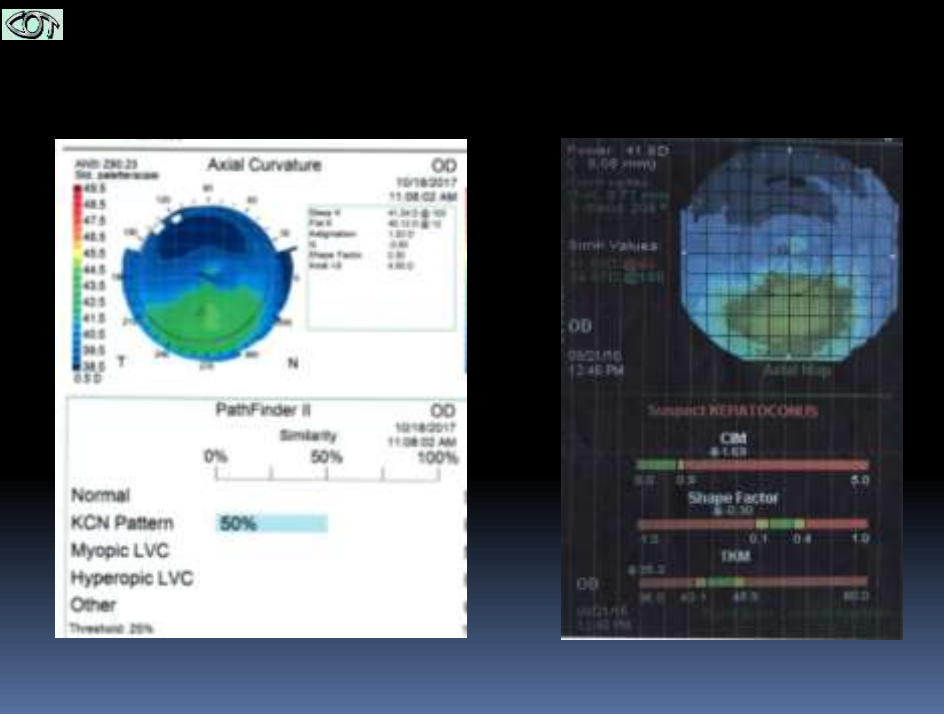
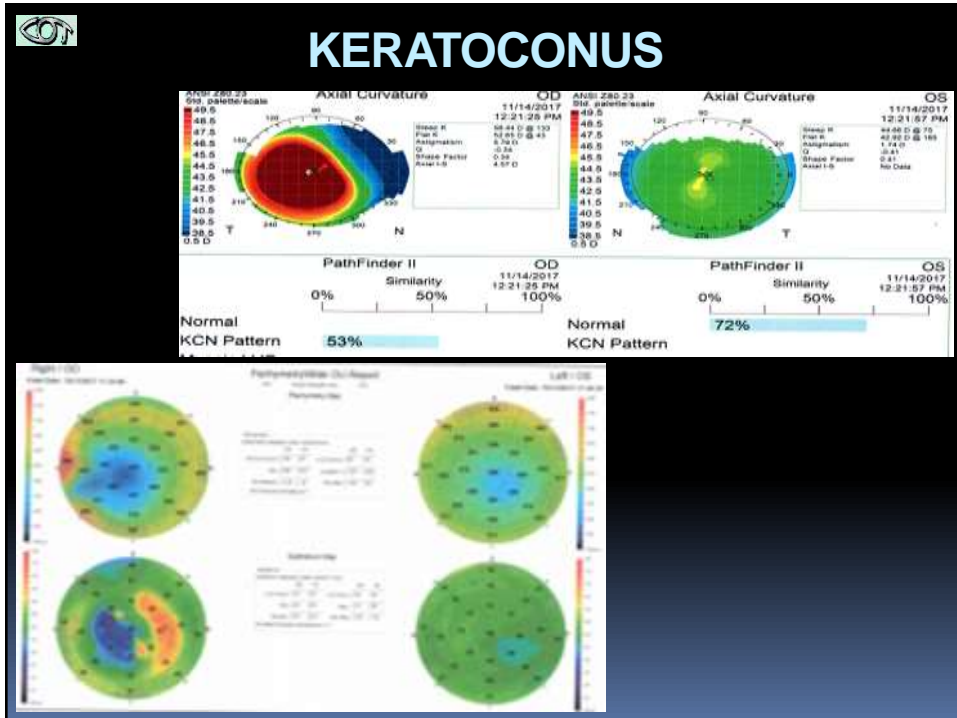


TABLE 6. Classification by Expert System (Cutoff Value 0.23)

Actual Category	Predicted Category		Sensitivity	Specificity	Accuracy
	Keratoconus	Nonkeratoconus			
Training set			100%	96%	97%
Keratoconus	22	0			
Nonkeratoconus	3	75			
Validation set			89%	99%	96%
Keratoconus	25	5			
Nonkeratoconus	1	71			

Automated keratoconus screening with corneal topography analysis.
 Maeda N¹, Klyce SD, Smolek MK, Thompson HW. *Invest Ophthalmol Vis Sci.* 1994



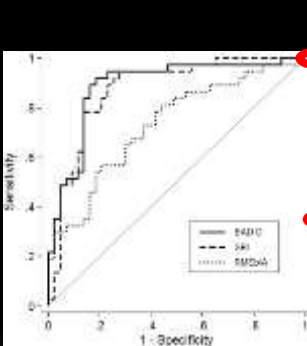
KERATOCONUS

- ◆ Cornea morphology : no bio marker
- ◆ Topography : spatial resolution 20-40 X
- ◆ Assymetry : I-S index
- ◆ Cut off value : sensitivity
- ◆ Composite index : automated detection
- ◆ **Additional tools : none discriminant nor superior**

Keratoconus Screening Indices and Their Diagnostic Ability to Distinguish Normal From Ectatic Corneas. Shetty et Al. Am J Ophthalmol. 2017



KERATOCONUS



Variable	AUC	Cut-off	Sensitivity (%)	Specificity (%)	LR ⁺	LR ⁻
Radius of posterior horn (R sphere) (mm)	0.992	4.37	87.0	87.1	4.74	0.13
Mean keratometry (D)	0.940	43.8	82.6	73.9	3.05	0.24
Standard deviation of corneal power (D)	0.833	45.48	65.7	94.7	13.30	0.37
Deep keratometry (mm)	0.828	7.645	82.6	69.7	2.73	0.23
Minimum posterior elevation in 3 mm zone (micrometers)	0.805	86.4	61	90	9.11	0.41
Keratometric astigmatism (D)	0.738	1.0	66.5	83.5	3.42	0.31
Minimum anterior elevation in 3 mm zone (micrometers)	0.679	0.735	82.6	51.1	1.69	0.14
Minimum posterior elevation in 3 mm zone (micrometers)	0.669	3.5	87.0	43.6	1.54	0.33
Keratometric astigmatism (D)	0.668	31.4	39.1	95.5	3.69	0.66
Minimum anterior elevation in 3 mm zone (micrometers)	0.664	0.445	73.9	54.1	1.65	0.43
Minimum posterior elevation in 3 mm zone (micrometers)	0.646	1.725	73.9	39.6	1.66	0.47
Minimum anterior elevation in 3 mm zone (micrometers)	0.644	0.990	42.5	91.7	3.24	0.62
Minimum posterior elevation in 3 mm zone (micrometers)	0.637	1.81	30.4	98.3	20.35	0.71
Minimum posterior elevation in 3 mm zone (micrometers)	0.637	32.5	91.3	38.3	1.49	0.23
Minimum anterior elevation in 3 mm zone (micrometers)	0.613	4.5	87.6	36.1	1.39	0.44
Minimum central thickness (micrometers)	0.604	325	42.5	82.6	2.98	0.68
Inferior superior index (D)	0.587	1.6	31.5	89.9	3.21	0.75
Keratometric astigmatism (D)	0.589	1.255	56.5	65.4	1.67	0.67
Central corneal thickness (micrometers)	0.584	334.5	43.9	81.5	1.66	0.66
Minimum anterior elevation in 7 mm zone (micrometers)	0.542	20.3	42.5	76.7	1.57	0.74
Minimum posterior elevation in 7 mm zone (micrometers)	0.539	29.3	30.4	67.2	1.34	0.68
Centre / maximum index (D)	0.534	0.99	21.7	100.0	NB	0.78

Keratoconus Screening Indices and Their Diagnostic Ability to Distinguish Normal From Ectatic Corneas. Shetty et Al. Am J Ophthalmol. 2017



KERATOCONUS

	R ²	AUC	Sensitivity (%)	Specificity (%)	LR ⁺ (%)	LR ⁻ (%)
Two-model structure						
Elevation + surface indices data	0.64	0.933	93.8	80.8	13.9	10.3
Elevation + keratometric data	0.64	0.925	98.4	81.1	17.7	10.3
Elevation + pachymetric data	0.43	0.924	97.7	80.3	17.8	10.3
Surface indices + keratometric data	0.6	0.921	86.0	77.4	10.1	10.3
Surface indices + pachymetric data	0.6	0.828	74.4	61.4	17.5	10.3
Keratometric + pachymetric data	0.45	0.752	54.3	41.2	24.0	10.3
Three-model structure						
Elevation + surface indices + keratometric data	0.65	0.952	97.7	84.6	13.4	10.3
Elevation + surface indices + pachymetric data	0.64	0.936	93.5	80.8	13.9	10.3
Elevation + keratometric + pachymetric data	0.6	0.926	96.1	78.7	18.1	10.3
Surface indices + keratometric + pachymetric data	0.6	0.926	87.6	78.9	9.9	10.3

R²: Nagelkerke Pseudo R²; AUC: area under the curve; LR: likelihood ratio

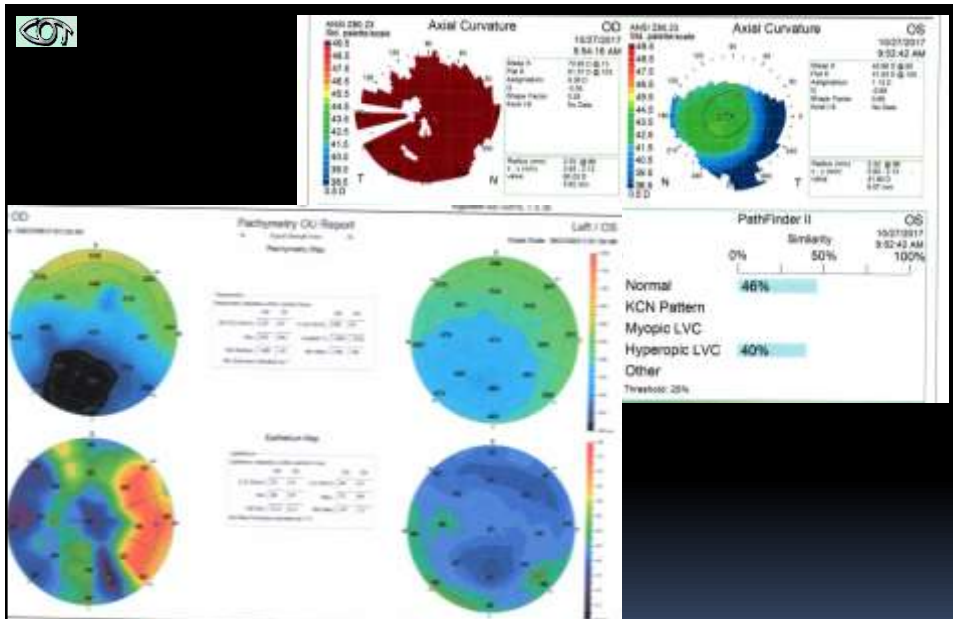
Predictive Ability of Galilei to Distinguish Subclinical Keratoconus and Keratoconus from Normal Corneas. Feizi et Al. J Ophthalmic Vis Res. 2016



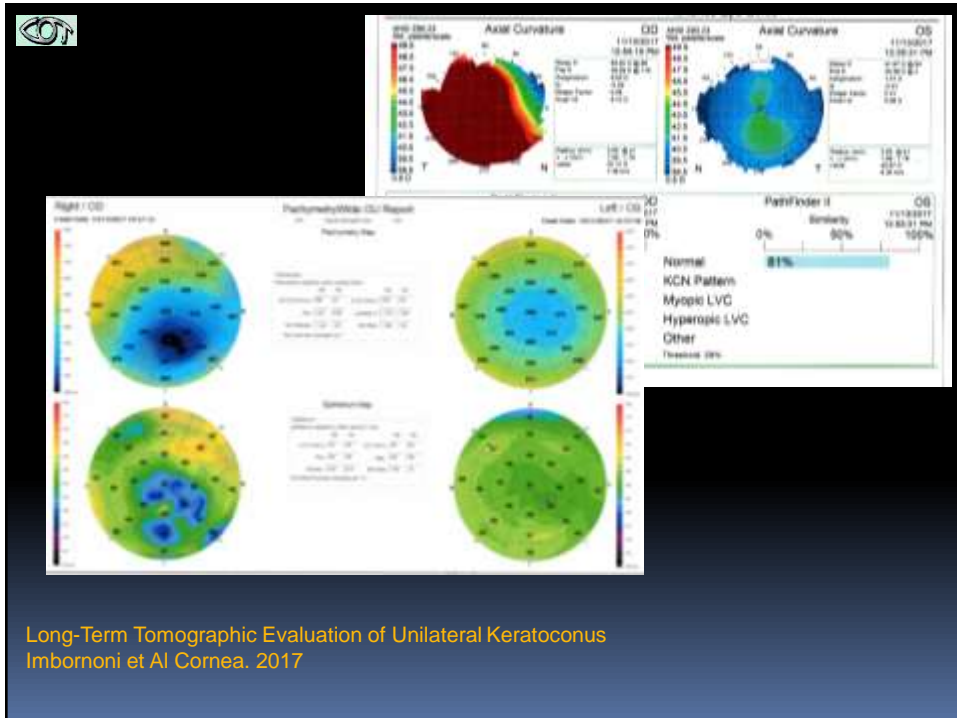
KERATOCONUS

- ◆ Topography (spatial resolution)
- ◆ Tomography (irregular)
- ◆ Aberrometry (coma)
- ◆ Biomechanic (morphology)
- ◆ HD OCT : cornea & epithelium

Comparison of corneal measurements in **keratoconus** using swept-source optical coherence tomography and combined Placido-Scheimpflug imaging. Chan et Al. Acta Ophthalmol. 2017



Distinguishing between contact lens warpage and ectasia: Usefulness of optical coherence tomography epithelial thickness mapping.



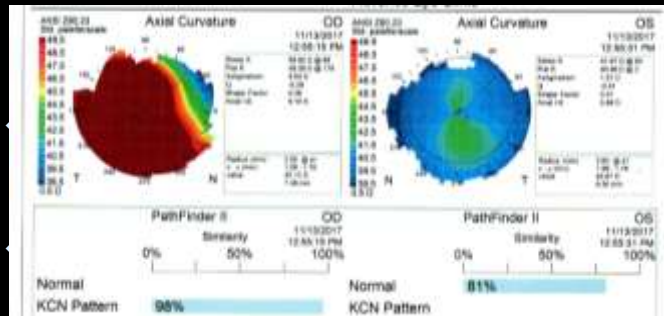
Validation Group

- ◆ Family Cohort
- ◆ Clinical keratoconus : stage I
- ◆ Fruste Keratoconus

Computer-assisted corneal topography in family members of patients with keratoconus.
Rabinowitz et Al Arch Ophthalmol. 1990



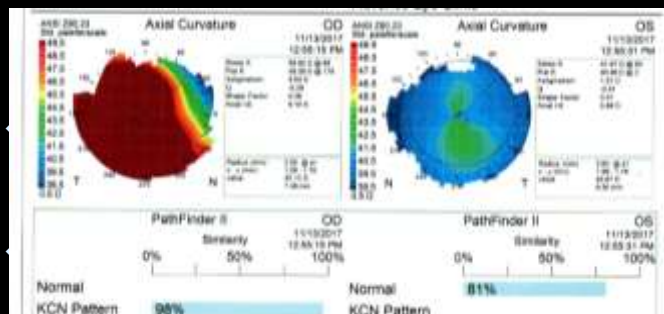
Validation Group



- ◆ Fruste Keratoconus :



Validation Group

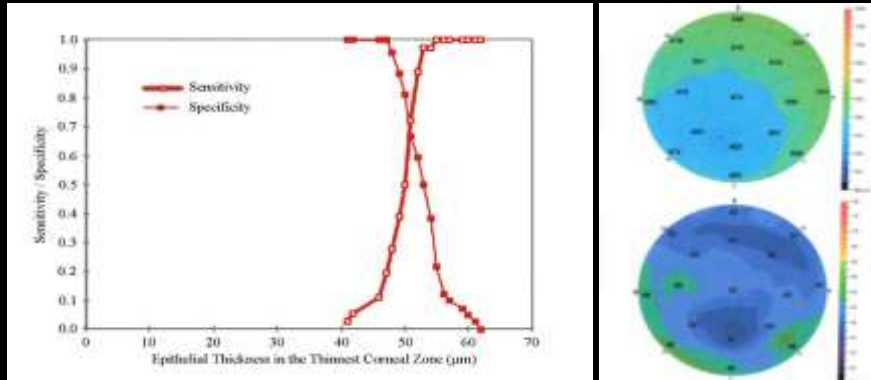


- ◆ Fruste Keratoconus : lower discriminance
lower cut off value

Keratoconus Screening Indices and Their Diagnostic Ability to Distinguish Normal From Ectatic Corneas. Shetty et Al. Am J Ophthalmol. 2017



Validation Group



- ◆ **Fruste Keratoconus : lower discriminance
lower cut off value**

Corneal epithelial thickness mapping using Fourier-domain optical coherence tomography for detection of form fruste keratoconus. [Temstet et Al, J Cataract Refract Surg. 2015](#)



Iatrogenic Ectasia

- ◆ **Keratoconus : major & independent risk factor**



Iatrogenic Ectasia

- ◆ Keratoconus : major & independent risk factor
- ◆ Topography : asymmetry (I-S)



Iatrogenic Ectasia

- ◆ Keratoconus : major & independent risk factor
- ◆ Topography : asymmetry (I-S)
- ◆ Cut off value : sensitivity > specificity



Iatrogenic Ectasia

- ◆ Keratoconus : major & independent risk factor
- ◆ Topography : asymmetry (I-S)
- ◆ Cut off value : sensitivity > specificity
- ◆ Additional tools & risk factors : none discriminant



Iatrogenic Ectasia

- ◆ Keratoconus : major & independent risk factor
- ◆ Topography : asymmetry (I-S)
- ◆ Cut off value : sensitivity > specificity
- ◆ Additional tools & risk factors : none discriminant
- ◆ Multivariate Expert System : independent & dependent factors

New perspectives on the detection and progression of keratoconus. Martínez-Abad et Al. J Cataract Refract Surg. 2017



Evidence Based Medecine



LASIK CALLED SAFEST,
MOST SUCCESSFUL
ELECTIVE PROCEDURE IN THE WORLD

Eric D. Donnenfeld
AAO 2017

