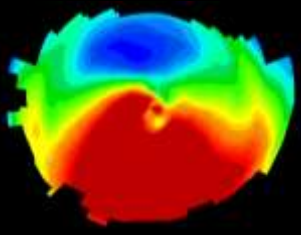
# POST LASIK ECTASIA
## What do you need to know



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( ISO 9002)

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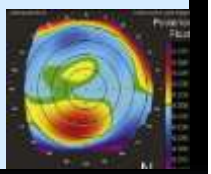
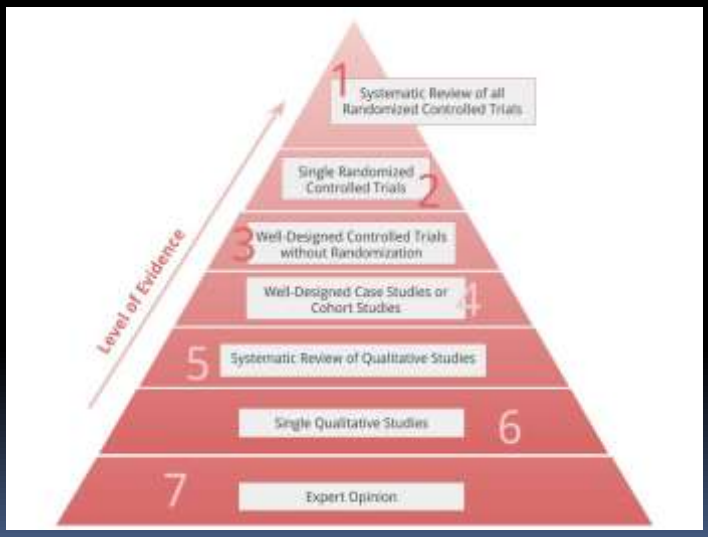
# ENQUETE NATIONALE SUR LES FACTEURS DE RISQUE DE L'ECTASIE CORNEENNE POST-LASIK



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

# Evidence Based Medecine




# *Randleman Score*

**Table 1. Ectasia Risk Factor Scoring System**

| Score | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Topography Pattern | Normal/symmetrical bowtie | Asymmetric bowtie | | Inferior steepening/ skewed radial axis | Form fruste 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) | -8 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 | |

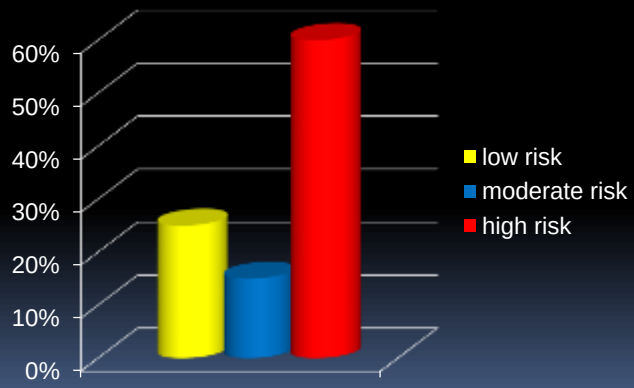
Validation of the Ectasia Risk Score System for preoperative laser in situ keratomileusis screening. Randleman et Al.Am J Ophthalmol. 2008

## Randleman Score Validity

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

## Tunisia Ectasia Study

**Low Randleman score : 25 %**



## Empirical Consensus

- Residual Stromal Bed : 200 >> 350 µ


## Biomechanical weakening

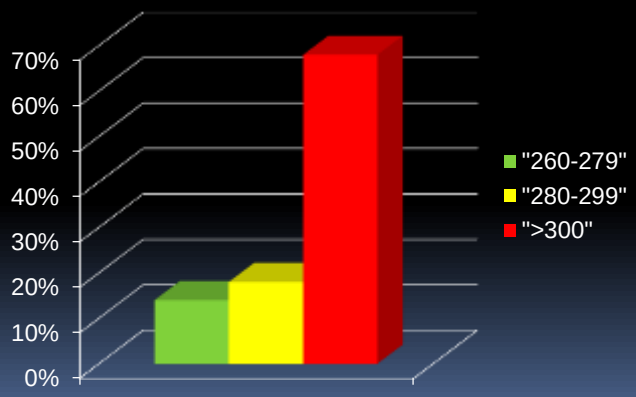
- Residual Stromal Bed : 200 >> 350 µ
- Percent Tissue Altered : < 40 %

**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

**> 300 µ ( 65 % )**




## *Randleman Score Validity*

- High Score : 50-92% ectasia
- Low Score : : 6-50% ectasia
- Independant and Non independant factors

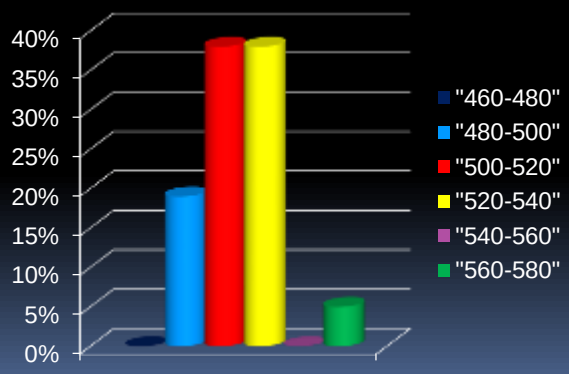
# Pachymetry

- Non Independant : 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

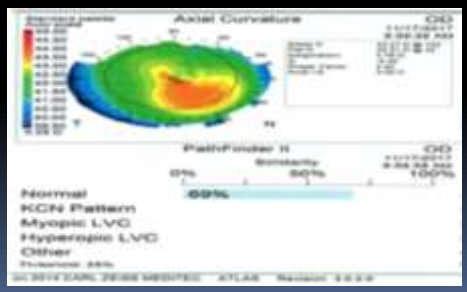
# Pachymetry

**> 500 µ ( 83 % )**



## Abnormal Topography

- Major & Independant factor : 49-90% ectasia

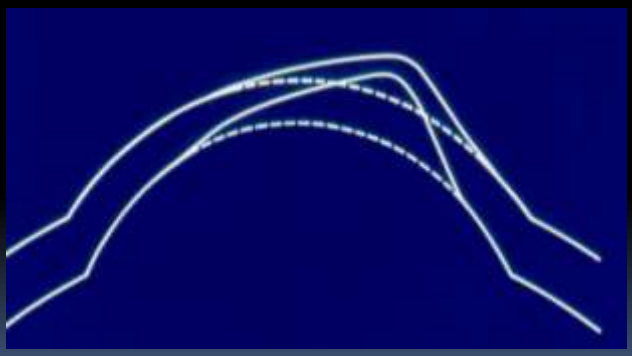



## Topographie

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

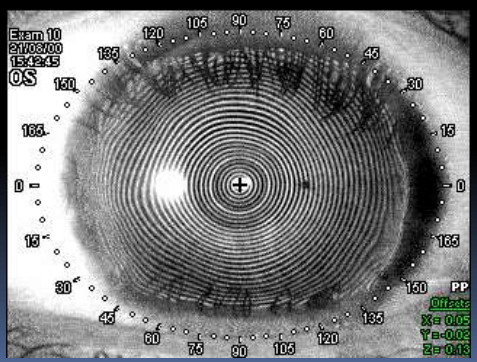
# KERATOCONUS

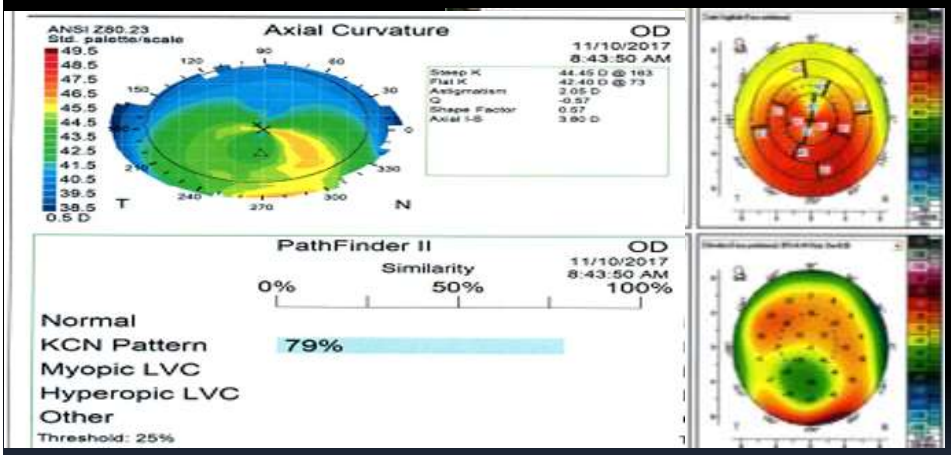
- Cornea morphology : no bio marker



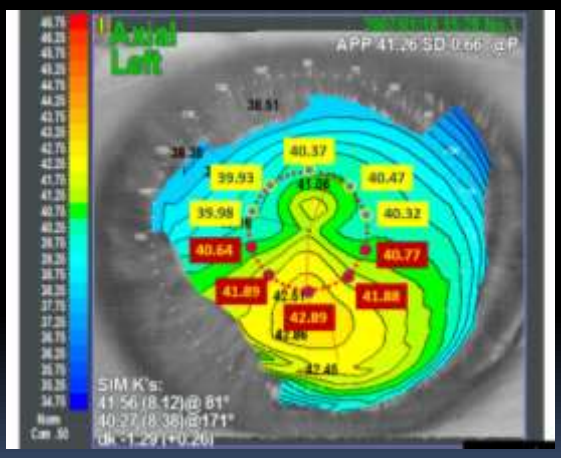
# Old not Out dated

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






# I-S Index ( Rabinovitz )




**1.2 >> 1.4**

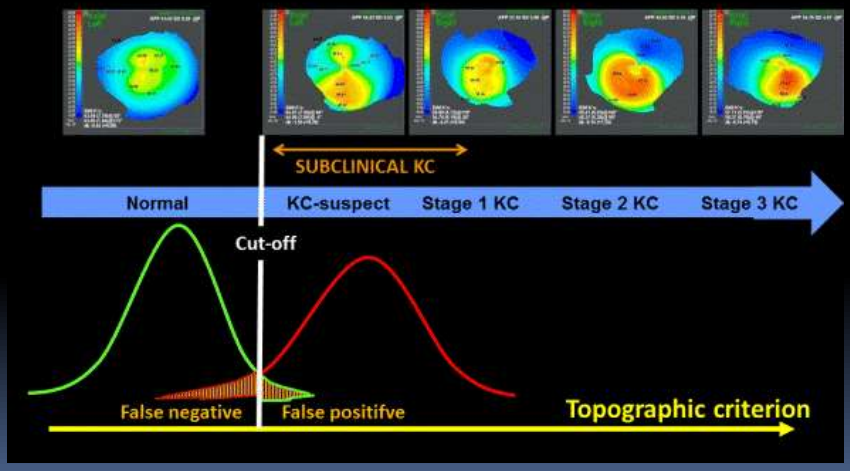
**Computer-assisted corneal topography in family members of patients with keratoconus.** Rabinowitz et Al Arch Ophthalmol. 1990

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

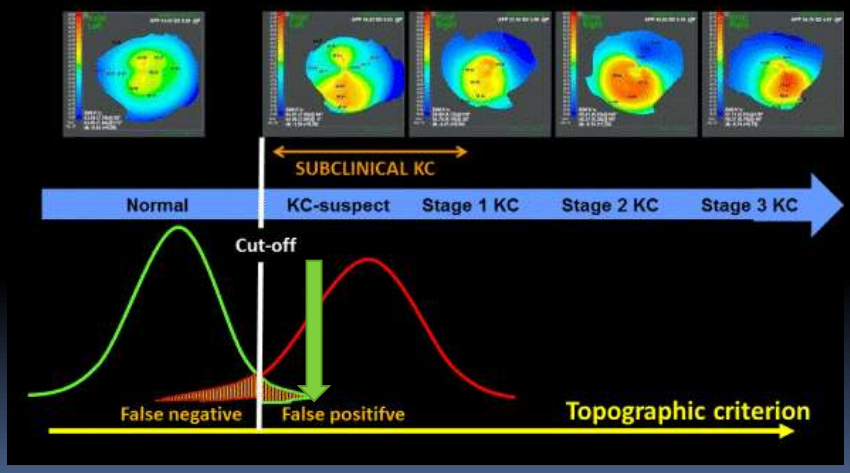
| | Predicted Category | | | | |
|---|---|---|---|---|---|
| *Actual Category* | *Keratoconus* | *Nonkeratoconus* | *Sensitivity* | *Specificity* | *Accuracy* |
| Training set | | | 100% | 96% | 97% |
| Keratoconus | 22 | 0 | | | |
| Nonkeratoconus | 3 | 75 | | | |
| Validation set | | | 89% | 99% |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

**Automated keratoconus screening with corneal topography analysis.**
Maeda N[1], Klyce SD, Smolek MK, Thompson HW. Invest Ophthalmol Vis Sci. 1994

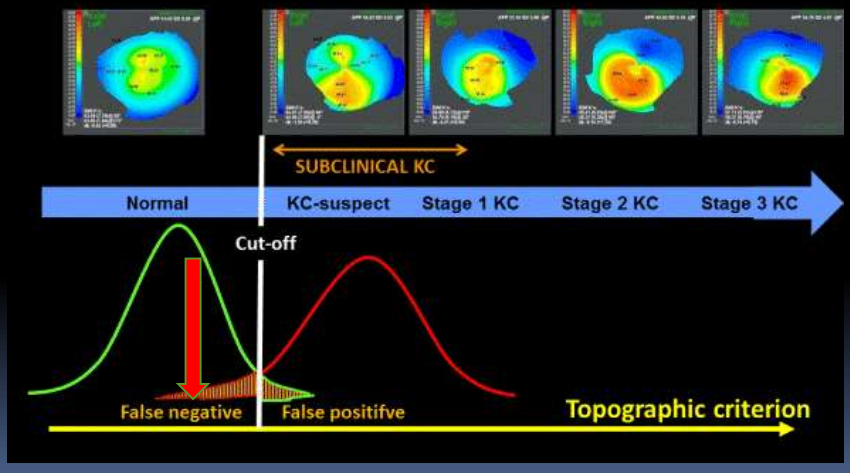
# specificity / sensitivity ( cut off value )



## specificity / sensitivity ( cut off value )

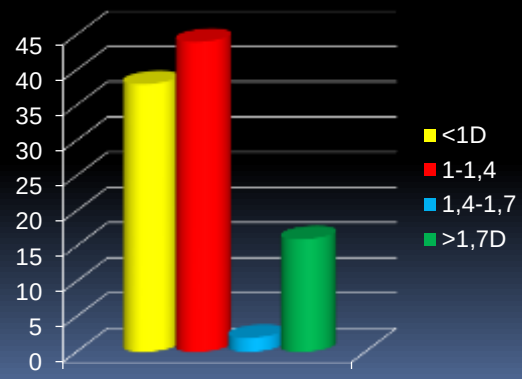



## specificity / sensitivity ( cut off value )



# I-S INDEX

**I-S > 1 ( 65 % )**




## Novel not Proven

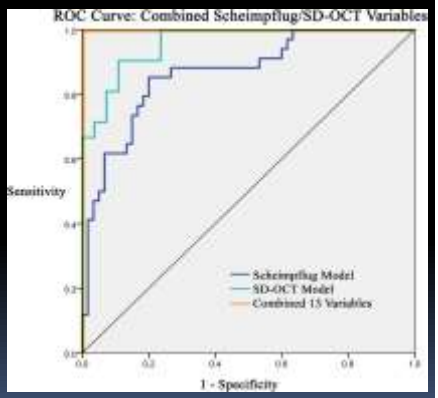
- Cornea morphology : no bio marker
- Topography : spatial resolution 20-40 X
- Assymetry : I-S index
- Cut off value : sensitivity
- Composite index : automated detection
- Additional tools : none discriminant nor superior

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

# KERATOCONUS

- SD OCT better than Scheimpflug

- 100% accuracy combination: **anterior curvature & asymmetry indices**
  **total & epithelial thickness variability**




**Distinguishing Highly Asymmetric Keratoconus Eyes Using Combined Scheimpflug and Spectral-Domain OCT Analysis.** Hwang , Perez-Straziota , Kim, Santhiago, Randleman . Ophthalmology 2018,

# KERATOCONUS

- SD OCT better than Scheimpflug

- 100% accuracy combination: **anterior curvature & asymmetry indices**
  **total & epithelial thickness variability**

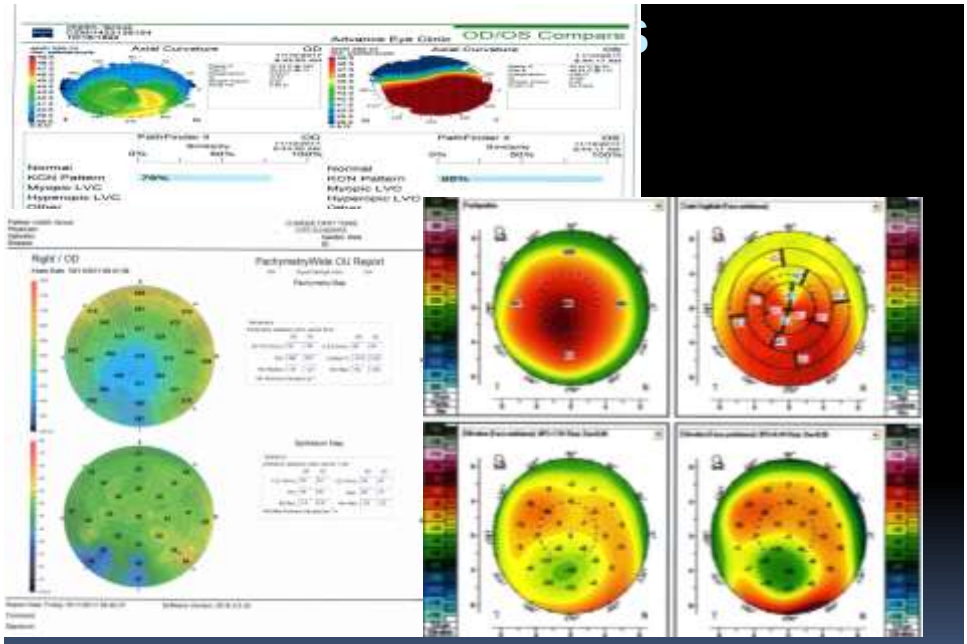
- **Posterior corneal indices not useful**

Table 1. Variable Rank by Impact on Combined Models to Distinguish Study Populations

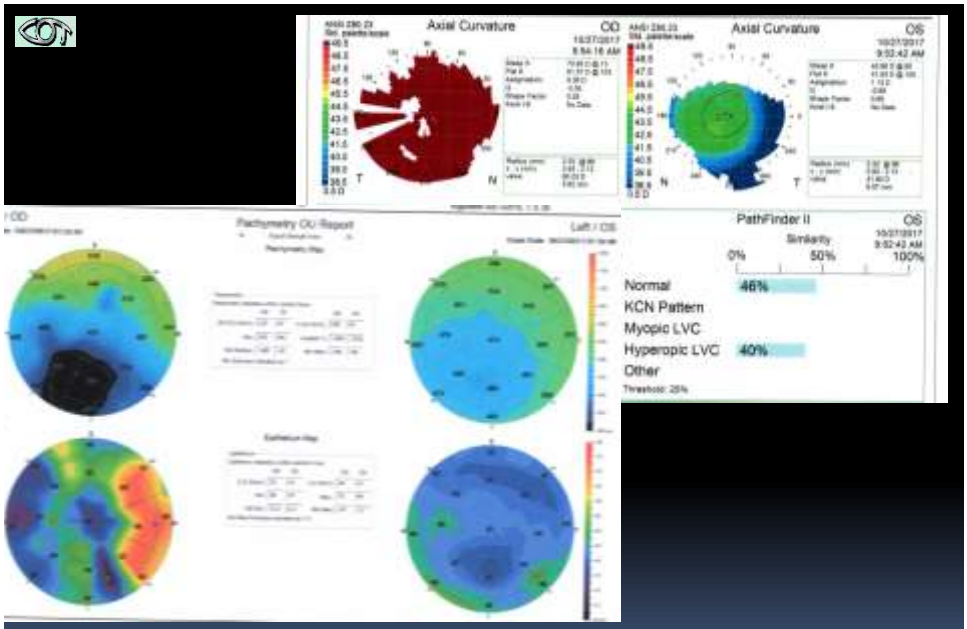
| Variable Rank | Scheimpflug (n=51) | SD-OCT (n=111) | Combined 13 Variables |
|---|---|---|---|
| 1 | IVA | Minimum-Median | Temporal outer (SD-OCT) |
| 2 | Pachymetry apex | Epithelium Minimum-Maximum | Pachymetry minimum (Scheimpflug) |
| 3 | BAD-D | Minimum | Temporal inner (SD-OCT) |
| 4 | ARTmax | Temporal outer | IVA (Scheimpflug) |
| 5 | Pi value | Superior nasal outer | Central (SD-OCT) |
| 6 | | Epithelium standard deviation | Epithelium standard deviation (SD-OCT) |
| 7 | | Superior outer | Minimum-median (SD-OCT) |
| 8 | | Central | ISV (Scheimpflug) |
| 9 | | Superior inner | Inferior temporal inner (SD-OCT) |
| 10 | | Superior nasal inner | Epithelium minimum-maximum (SD-OCT) |
| 11 | | Superior temporal outer | Minimum (SD-OCT) |
| 12 | | | Superior outer (SD-OCT) |
| 13 | | | |
| AUC | 0.96 | 0.96 | 1.0 |
| Sensitivity | 91% | 91% | 100% |
| Specificity | 91% | 99% | 100% |

ARTmax = Ambrosio's Relational Thickness Maximum; AUC = area under the curve; BAD-D = Belin-Ambrosio Deviation Score; BID = index height decentration; IS = inferior-superior; ISV = index surface variance; IVA = index vertical asymmetry; SD = spectral-domain.

**Distinguishing Highly Asymmetric Keratoconus Eyes Using Combined Scheimpflug and Spectral-Domain OCT Analysis.** Hwang , Perez-Straziota , Kim, Santhiago, Randleman . Ophthalmology 2018,

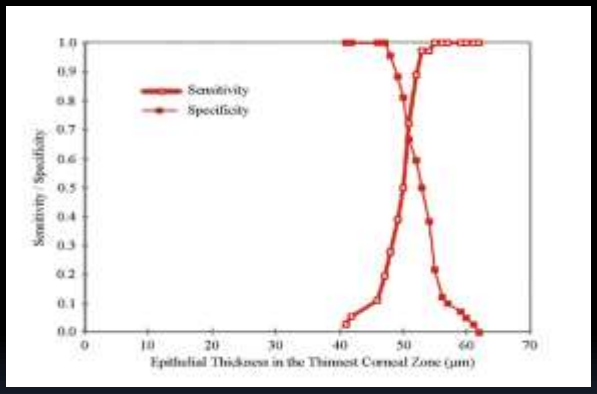


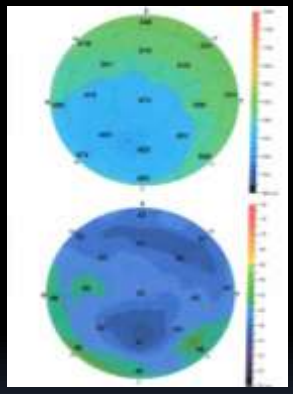

Comparison of corneal measurements in **keratoconus** using swept-source optical coherence tomography and combined Placido-Scheimpflug imaging. Chan et Al. Acta Ophthalmol. 2017




Distinguishing between contact lens warpage and ectasia: Usefulness of optical coherence tomography epithelial thickness mapping. Schallhorn et Al. J Cataract Refract Surg. 2017

# HD OCT



**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

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## 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

## Back to the future

- keratoconus detection with 100% sensitivity & specificity using only Placido curvature data
- Why is not used more often for screening ?
- Lack of large sample is a common problem in Artificiel Intelligence medical diagnostics

The Future of Keratoconus Screening with Artificial Intelligence,Klyce,Ophthalmology 2018