Correlation between Clinical and Pentacam Findings in KC

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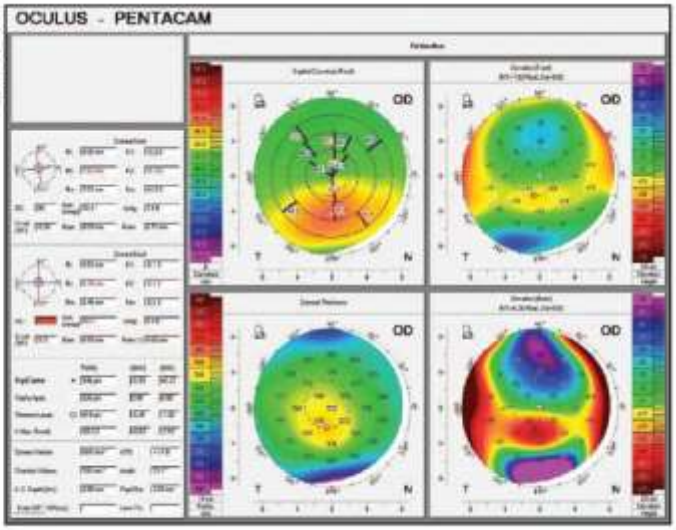
The Pentacam offers the ability to view measured tomographic data in many different formats, depending on the needs of the clinician. The four-map view is the "standard" view of the Pentacam.

The four-map refractive view presents 4 maps that are most useful to clinicians screening patients for refractive surgery.

This view shows the traditional axial map, anterior elevation map, posterior elevation map, and pachymetric map.

Each map provides valuable data regarding the health and structure of the cornea. When viewed together as a group, a tremendous amount of data are available to the clinician on one page.

Figure 7-18. A classic example of early keratoconus is shown. Early posterior elevation can be seen, which precedes changes on the anterior surface. Inferior steepening is seen in the inferior portion of the sagittal curvature map.



4 Map Curvature map and keratoconus

- It is important to realize that we cannot rely on corneal curvature to diagnose keratoconus. Curvature is a reference-based measurement that changes with the angle of evaluation.
- A decentered apex will always lead to focal areas of curvature steepening (when no true abnormality exists). True elevation maps do not make these assumptions and are independent of the reference axis
- Therefore, we suggest examining an eye's elevation and pachymetry maps first and the curvature map last.

Keratoconus is a non inflammatory corneal disorder characterized by:

Corneal steepening

Corneal thinning

Corneal irregular, against the rule astigmatism

Bilateral but asymmetrical

Decentred cone

K max > 47 D

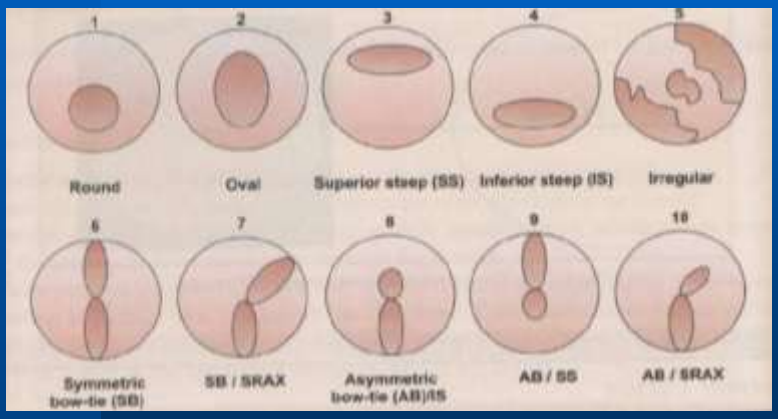
REGULAR PATTERNS :

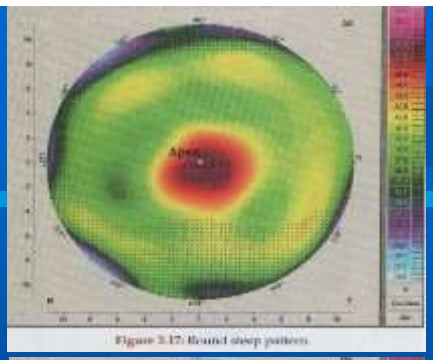
- Round
- Oval
- Steepening : Superior or Inferior

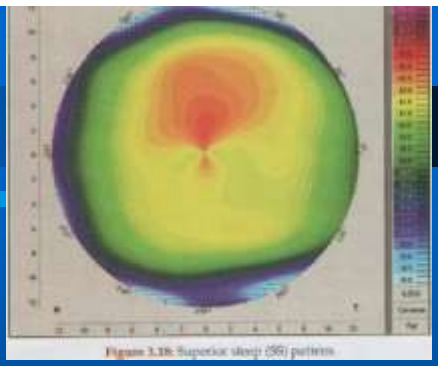
ASTIGMATIC PATTERNS:

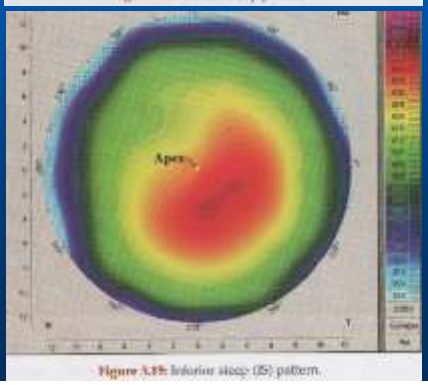
- Symmetrical & Orthogonal : (Bow-Tie Effect)
  - With or without skewed axis
- Asymmetrical & Orthogonal:
  - With superior steepening
  - With inferior steepening
  - Bow-tie with skewed radial axis
- Irregular : no pattern and non-orthogonal

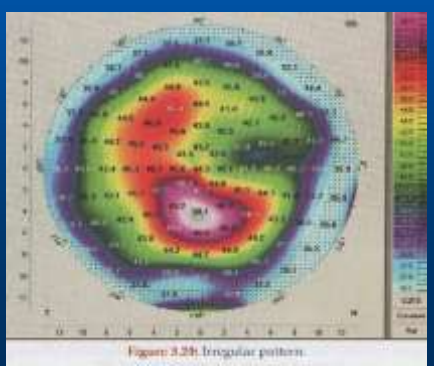
K max > 47 D


1
2
3
4
5
Round
Oval
Superior steep (SS)
Inferior steep (IS)
Irregular
6
7
8
9
10
Symmetric bow-tie (SB)
SB / SRAX
Asymmetric bow-tie (AB)/IS
AB / SS
AB / SRAX









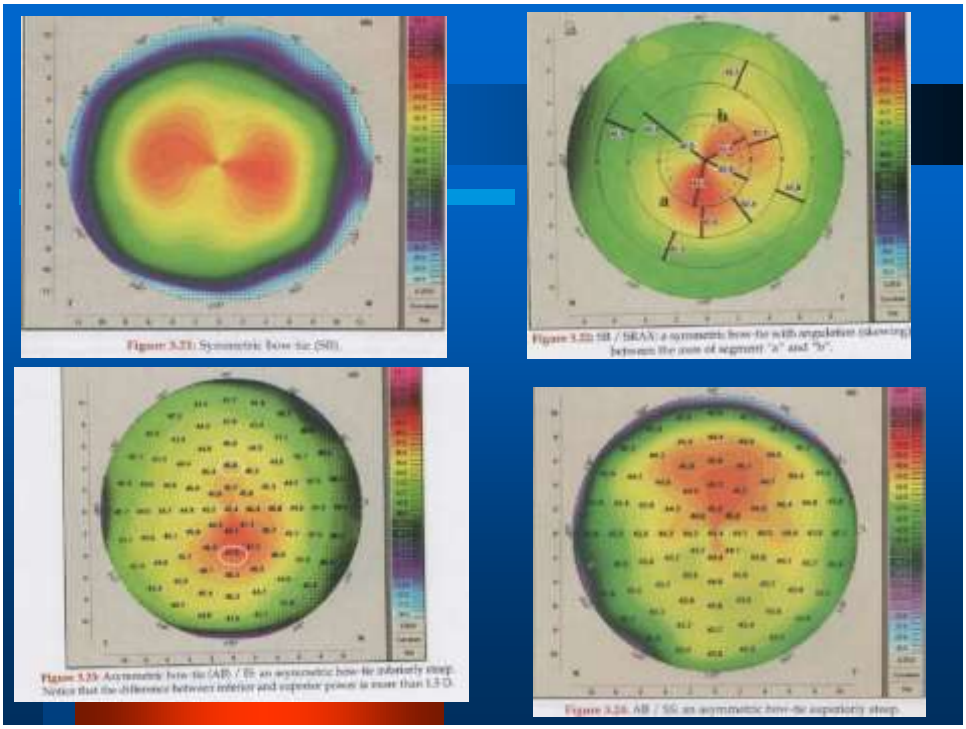


Figure 3.21: Symmetric bow-tie (SB).

Figure 3.22: SB / SRAX: a symmetric bow-tie with angulation (skewing) between the axes of segment "a" and "b".

Figure 3.23: Asymmetric bow-tie (AB) / IS: an asymmetric bow-tie inferiorly steep. Notice that the difference between inferior and superior power is more than 1.5 D.

Figure 3.24: AB / SS: an asymmetric bow-tie superiorly steep.

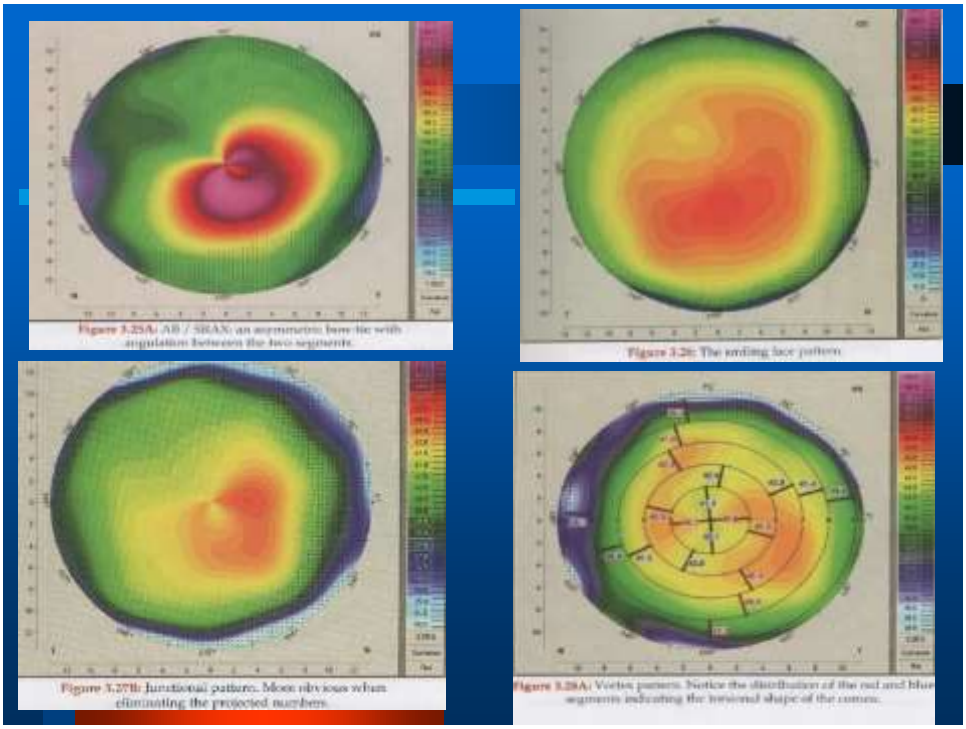


Figure 3.25A: AB / SRAX: an asymmetric bow-tie with angulation between the two segments.

Figure 3.26: The smiling face pattern.

Figure 3.27B: Junctional pattern. More obvious when eliminating the projected numbers.

Figure 3.28A: Vortex pattern. Notice the distribution of the red and blue segments indicating the torsional shape of the cornea.

Corneal Thinning

- Eyes with KC, or subclinical KC, typically have thinner corneas than normal eyes.
- Keratoconic eyes also have a more progressive increase in corneal thickness from the center to the periphery.
- In other words, there is a more rapid increase in thickness when moving from the center to the periphery in eyes with keratoconus than in normal eyes.

Furthermore, the thinnest point of a keratoconic eye typically is inferior to the center of the cornea, which is known as inferior displacement. The pachymetric map on the Pentacam is useful to detect these differences in eyes with possible KC .

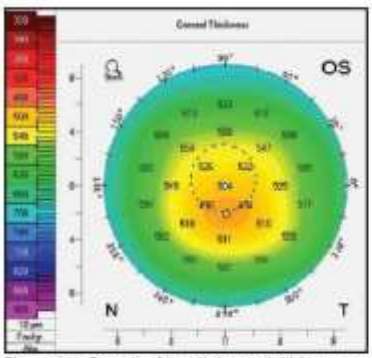


Figure 7-14. Example of a typical corneal thickness map with off-axis thinning, which is suspicious for early keratoconus.

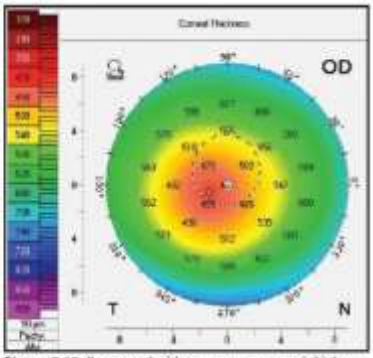


Figure 7-15. Compared with an average corneal thickness of 530 µm, this corneal thickness map is unusually thin at 455 µm.

Thickness Profiles

These profiles are unique in the Pentacam.

There are two pachymetry profiles:

- **Corneal Thickness Spatial Profile (CTSP) describes the average progression of thickness starting from the TL to corneal periphery in relation to zones concentric with the TL.**
- **Percentage Thickness Increase (PTI) describes the percentage of this progression.**

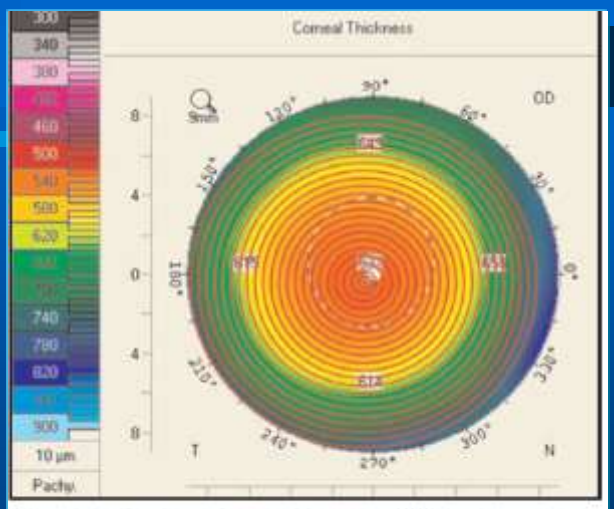


Figure 13. Top down view of the corneal thickness spatial profile showing 22 imaginary concentric circles centered on the TP. The pachymety values along these circles are averaged and graphed on the CTSP graph.

The normal profile is a curve plotted in red, following (but not necessarily within) the course of the normative black dotted curves, with an average of 0.8–1.1 .

When there is a fast transition of thickness between the TL and corneal periphery, the average will be high, and vice versa .

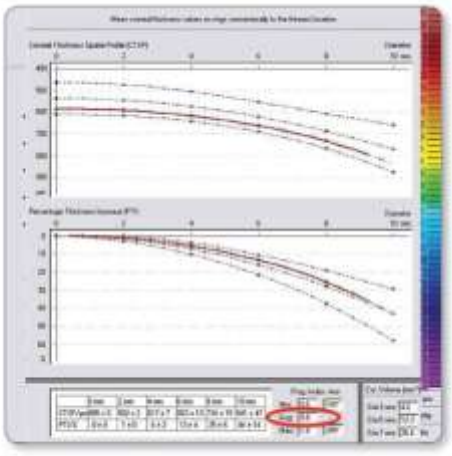


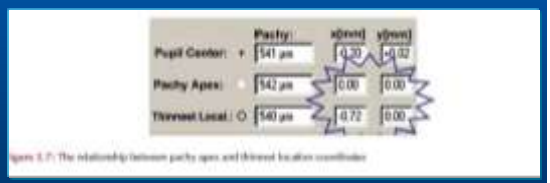
Fig. 2.39 Thickness profiles. A normal profile follows the normative curves with an average < 1.2 (red ellipse)

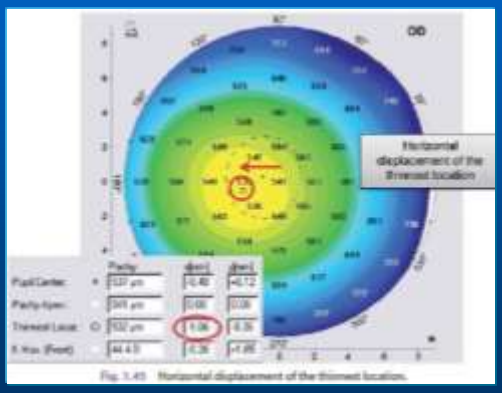
Percentage of Thickness Increase (PTI) is calculated using a simple formula:

(CT@x - TP) / TP

where x represents diameter of imaginary circle centered on the TP with increased diameters as provided by the CTSP

Coordinates



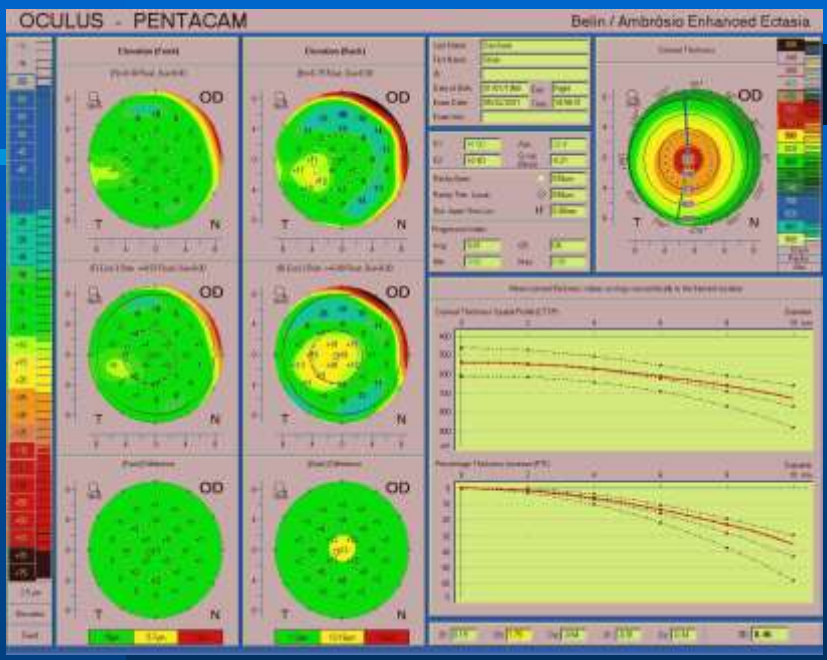


Belin / Ambrósio Enhanced Ectasia Display:

The goal of the ***Belin / Ambrósio Enhanced Ectasia Display is to combine elevation based and pachymetric corneal*** evaluation in an all inclusive display.

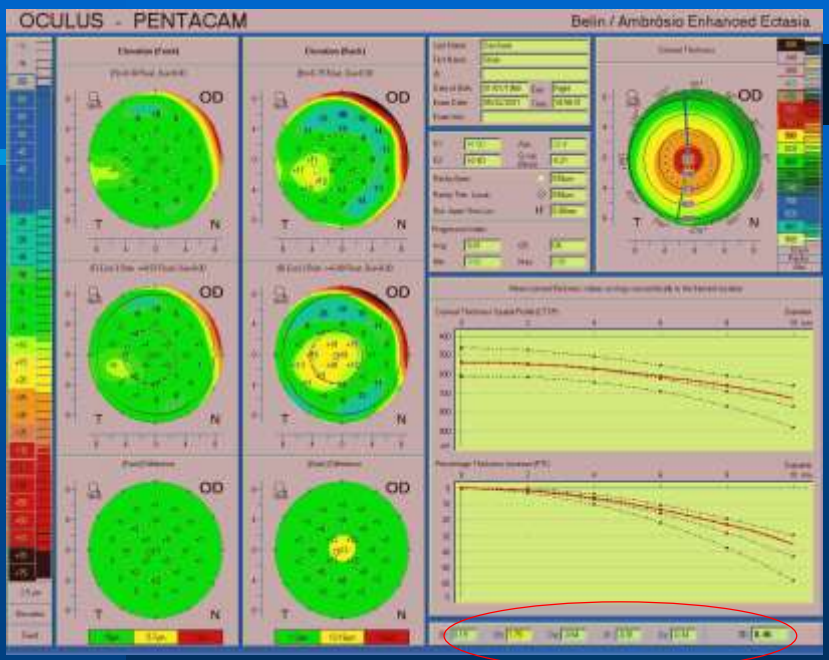
This gives the clinician a global view of the structure of the cornea and allows the physician to quickly and effectively screen patients for ectatic disease.

The elevation maps and pachymetric data are placed side by side in a comprehensive display.



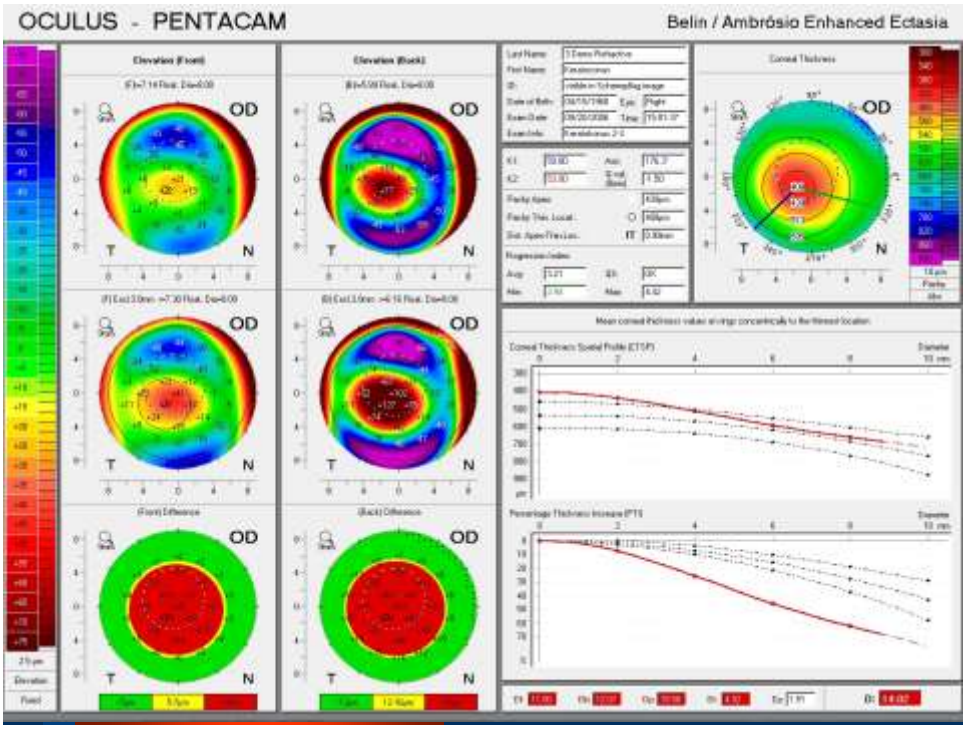
BAD II

- It reports five new terms (*D values for* standard deviation from the mean) representing the front surface (*Df)*, back surface (*Db)*, *pachymetric* progression (*Dp)*, *thinnest point (Dt)*, and thinnest point displacement (*Dy).*
- A sixth term (D) is the final overall map reading taking each of the five parameters into account.
- The individual parameters are also colour coded based on their variation from the normal.



The parameter is indicated in YELLOW (suspicious) when it is ≥ 1.6 SD from the mean and turns RED (abnormal) at ≥ 2.6 SD from the mean. Values below 1.6 SD are reported in WHITE and are viewed as within the normal range.

The major advance is that while an individual parameter(s) may fall outside the norm the final overall comprehensive reading may still be viewed as normal. Conversely, multiple YELLOW or suspicious parameters may be significant enough for the final reading D to be RED or abnormal

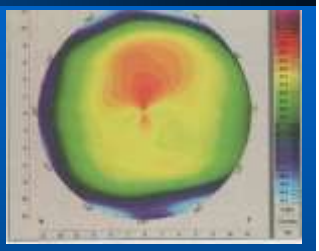


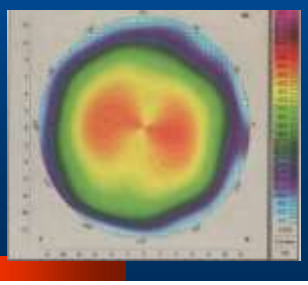
Irregular Astigmatism > 6 D

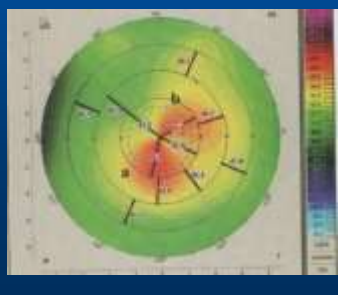
Lobes????

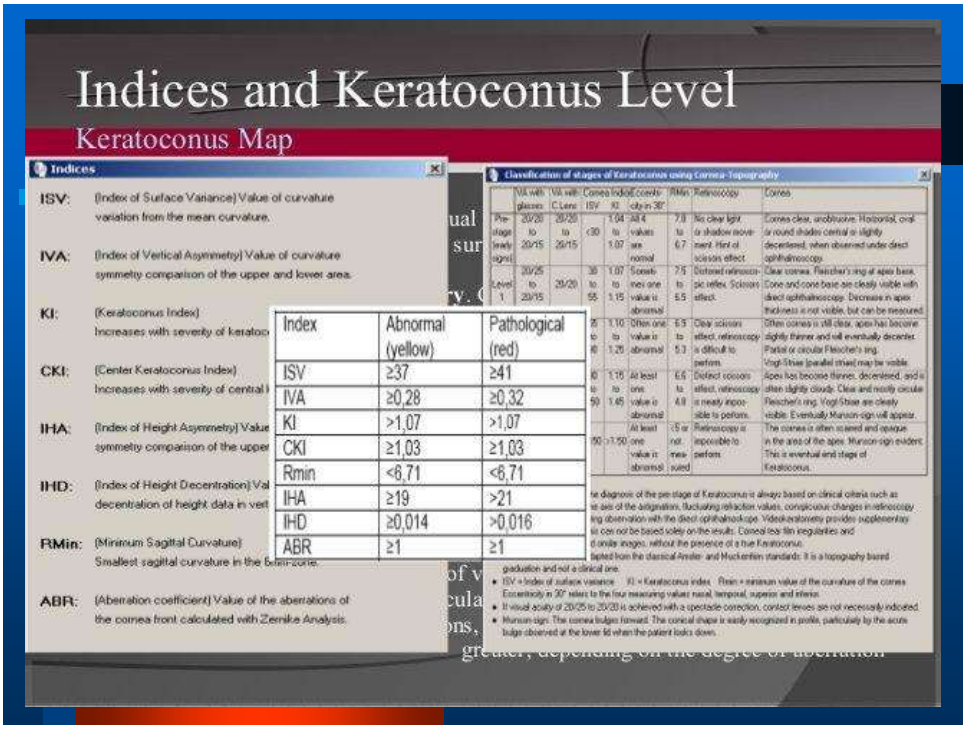
Angeled or Not????

Axis????









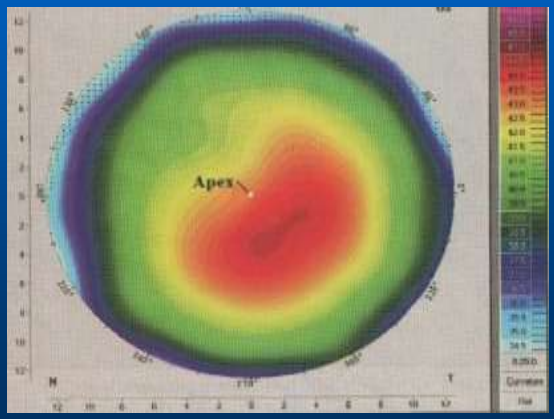
Bilateral and Asymmetrical

Difference in K reading > 2 D.

Difference in thickness > 30 u .

Decentered Cone

I-S ratio



Rowsy rule of 2's

K max > 2 D steeper than 45 D

Difference > 2 D between the 2 eyes

I-S > 2 D at 6 mm OZ

Skewness > 22

Peripheral thickness >20% of central thickness

Occult KC

Table 3.1: The normal, suspected and abnormal findings in corneal topography

	Normal value(s)	*Suspected value(s)*	*Abnormal value(s)*
Quality specification (QS)	white	yellow	red
K-readings:	look at flat K for myopic treatment, look at steep K for hyperopic treatment		>48
Corneal astigmatism	compare with manifest astigmatism		> 6
Average Q-value	0 to -1		0,-1
Topometric map (vertical and inferior Q-values)		-0.5 to -0.55	>-0.55

Thinnest location			
Thickness	> 500	470 – 500	< 470
Difference in thickness between patchy apex and thinnest location	< 5 µ	5 – 10 µ	>10 µ
Coordinates	< 500 µ	500 – 1000 µ	>1000 µ
Pupil center coordinates	important for treating hyperopia and >3D astigmatism		

Contd...

	Normal value(s)	*Suspected value(s)*	*Abnormal value(s)*
KPD	<+0.75	+0.75 to +1.5	>+1.5
Anterior curvature map			
Maximal K	important when treating hyperopia		
Pattern	refer to topographical patterns		
I-S Rabinovich ratio			>+2
Skewed Steepest Radial Axis Index (SRAX)			>22°
Superior-inferior difference on the 4 mm circle			>1.5D when the inferior is steeper >2.5 when the superior is steeper

Elevation maps (within the 4 mm central circle)			
Anterior	≤12 µ	13 - 15 µ	>15 µ
Posterior	≤17 µ	18 – 20 µ	>20 µ
Anterior-posterior difference	<5 µ	>5 µ	
Isolated island (or tongue like extension)	might be an indicator for FFKC or subclinical keratoconus		
Corneal thickness map			
Shape		cone like	
Superior-inferior difference	<30 µ	>30 µ	
Thinnest location difference between both eyes	<30 µ	>30 µ	
Keratoconus diagram			
Shape and location of the curve		- out of normative range - deviation before the 6 mm circle	


Thank You