Belin Ambrosio (BAD) V4:
What's New ?

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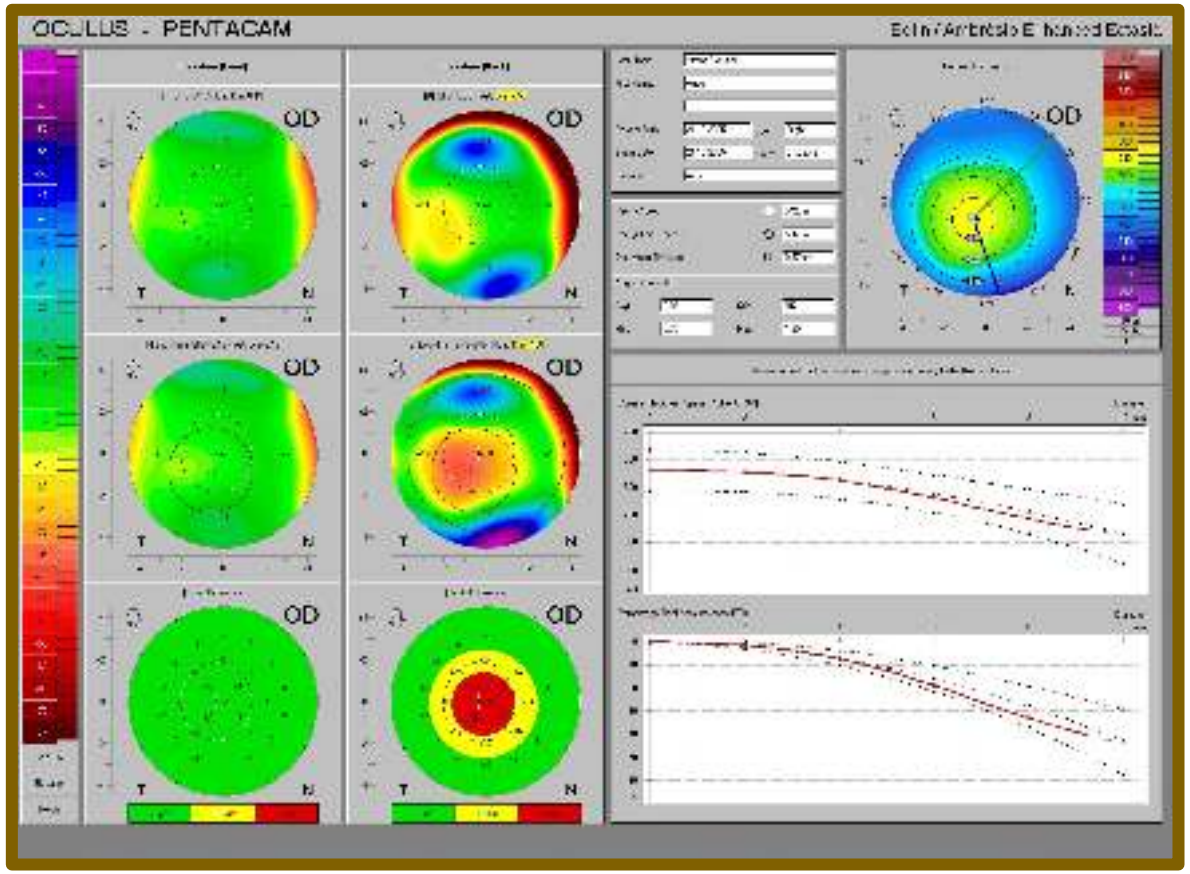
Belin Ambrosio ~~Enhanced Ectasia~~ Display

Why the Name Change ?

- Prior misconception that the BAD display is specific for Keratoconus
  - It is Not
- Original BAD display was designed for Refractive Screening
  - Separate “normal” from “abnormal”

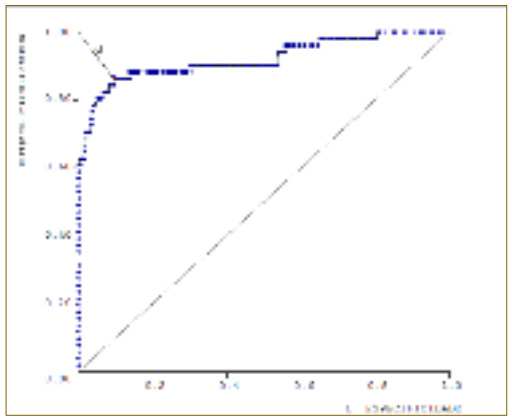
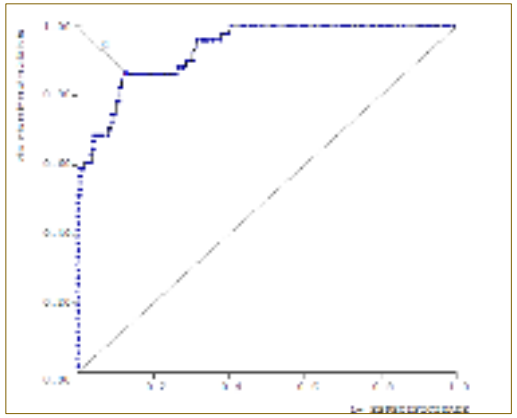
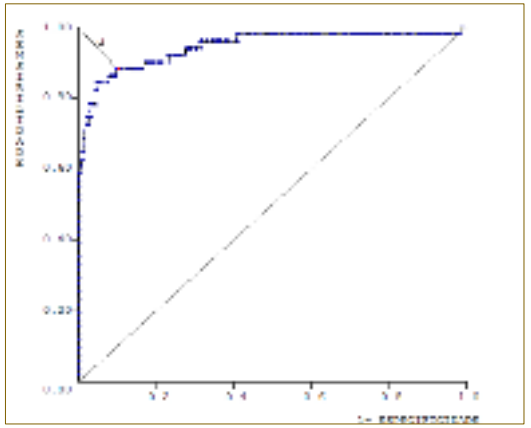
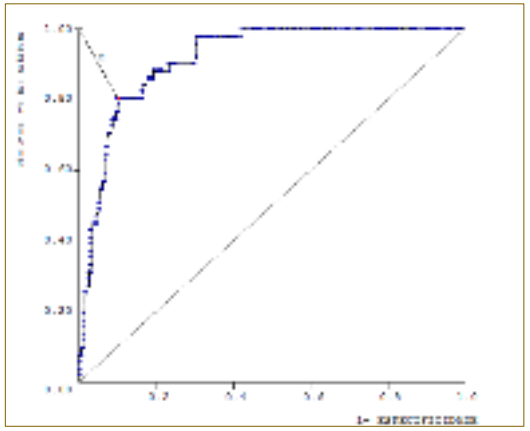
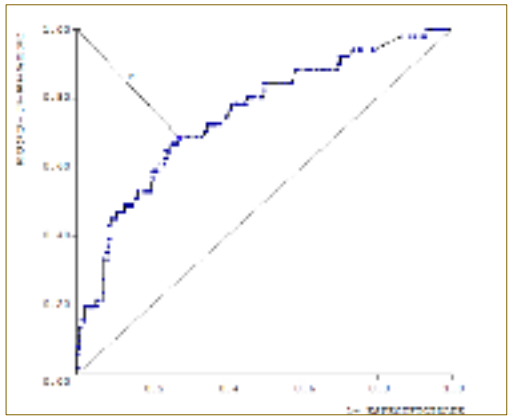
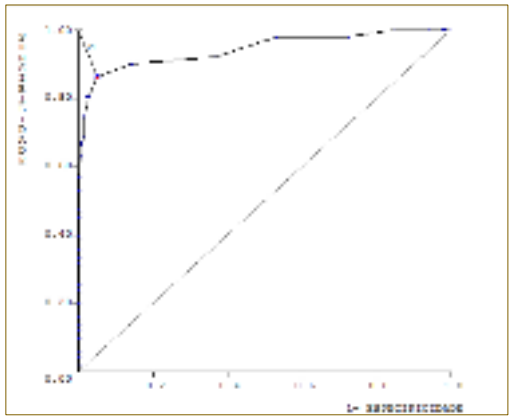
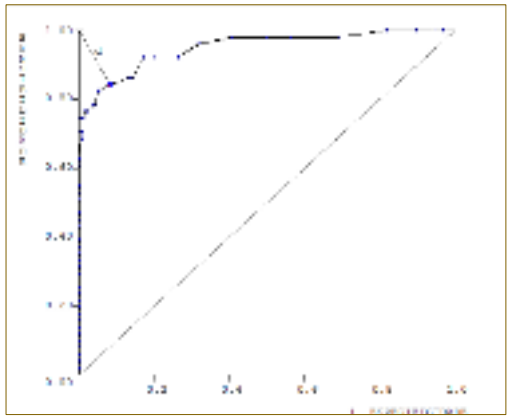
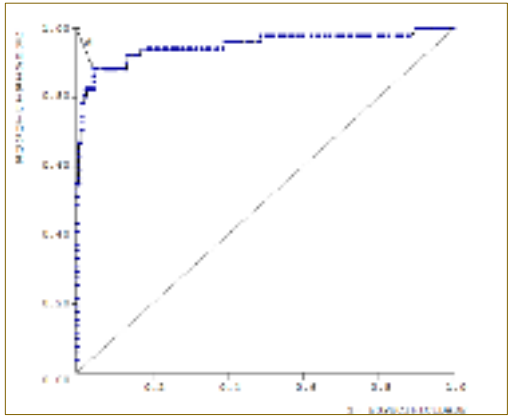


Version 1

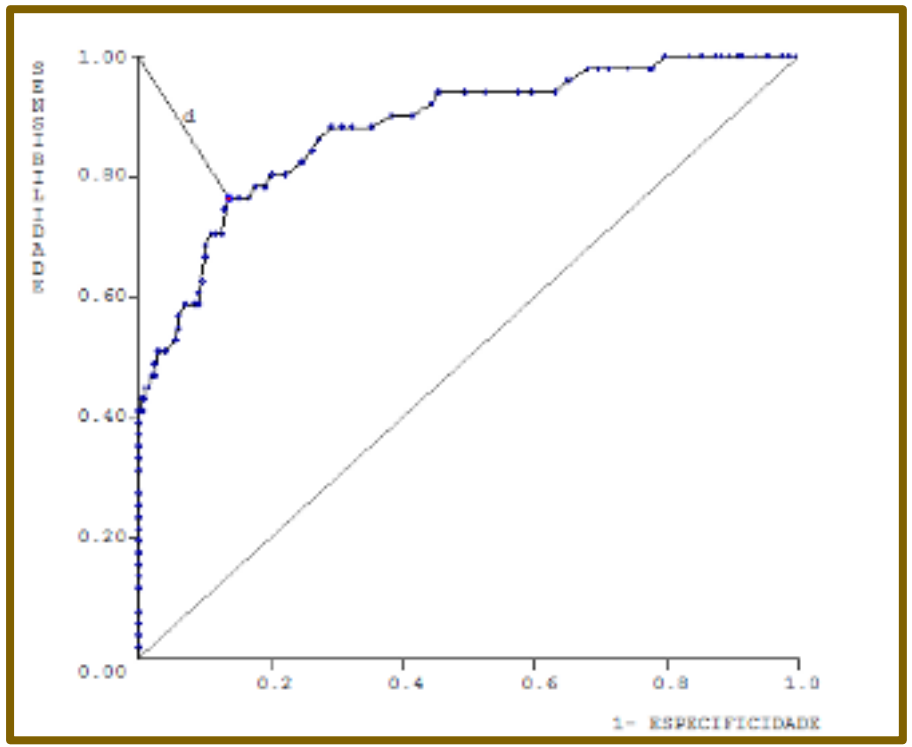
Improvements Made to BAD III

- Added four additional parameters
  - Elevation at Thinnest Point
    - Anterior
    - Posterior
  - Kmax
  - ARTmax
- Hyperopic database
  - Use in Hyperopia & Mixed Astigmatism
- Drop down explanations for all parameters
- Option to turn-off colors for small “d”

Only Parameters that Improve Performance are added to the Regression Analysis

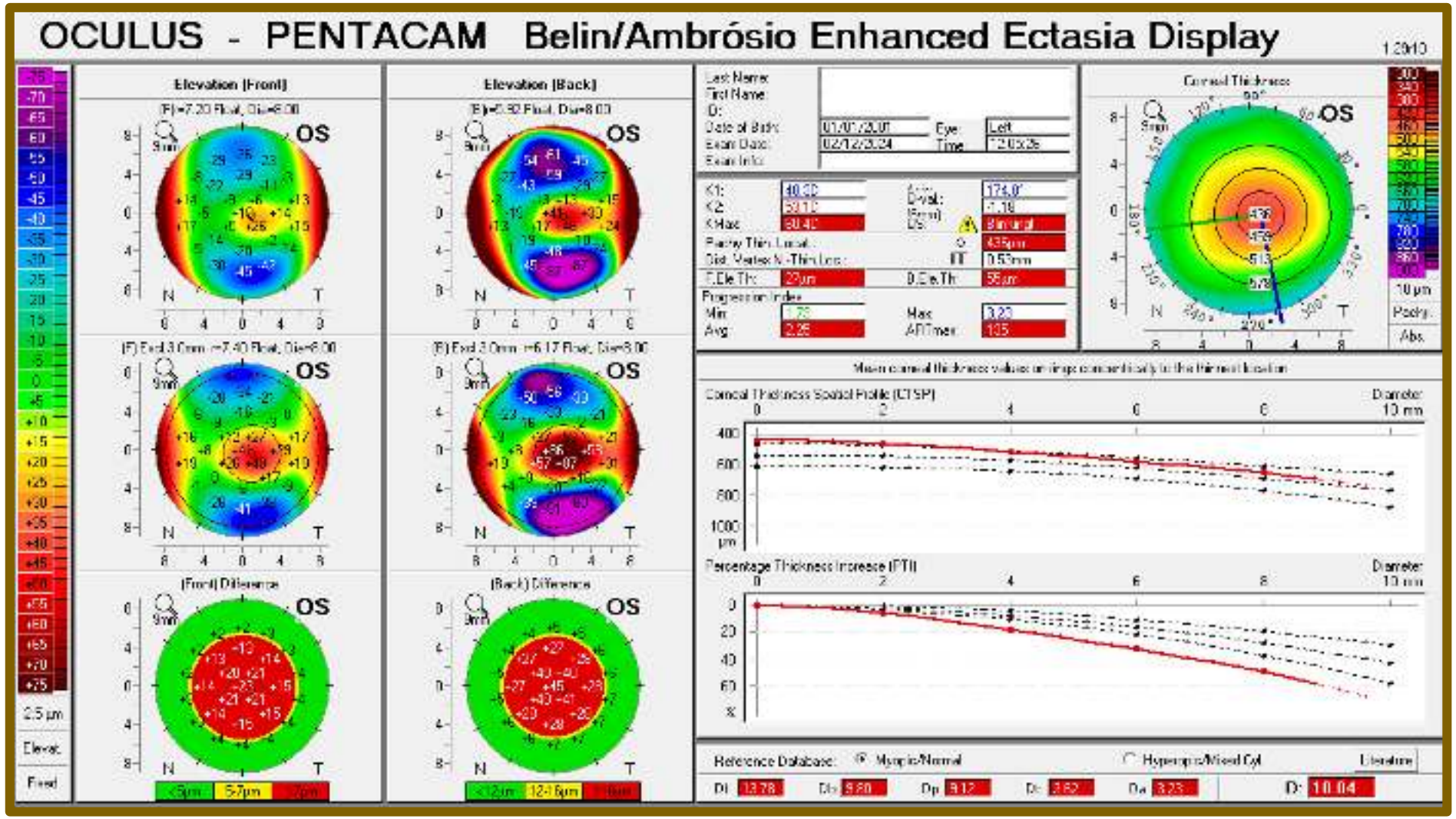









Only Parameters that Improve Performance added to the Regression Analysis (ALMOST)



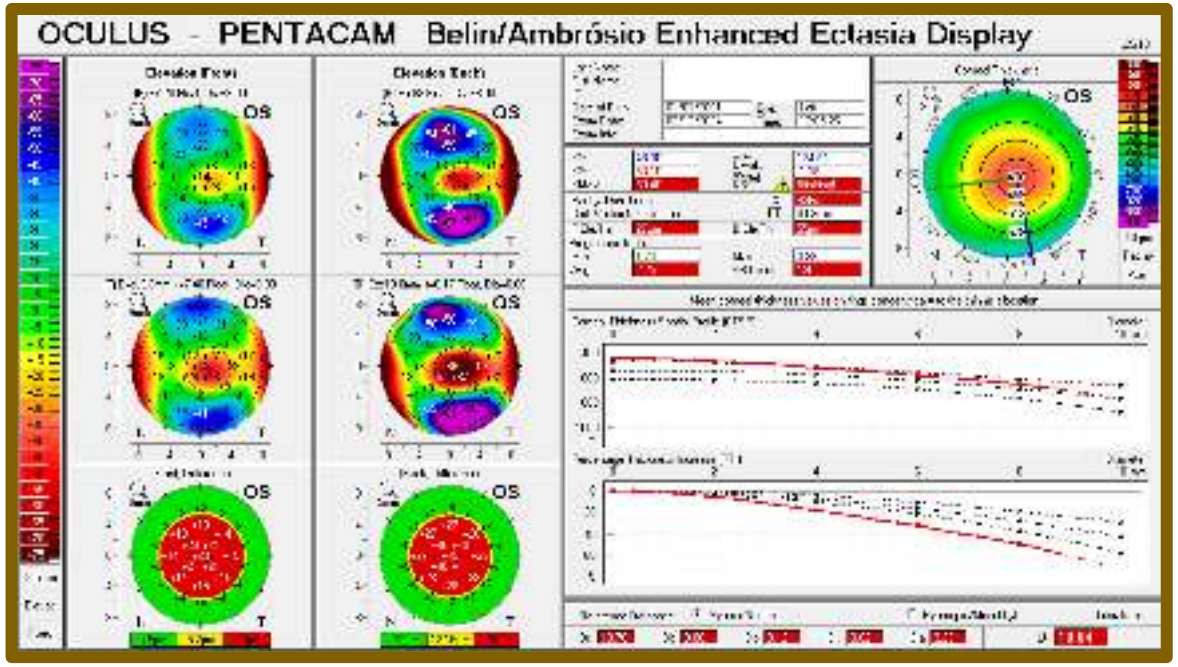
Kmax added due to public request, though it did not improve performance

Current Version – BAD v3



Features of the BAD v3

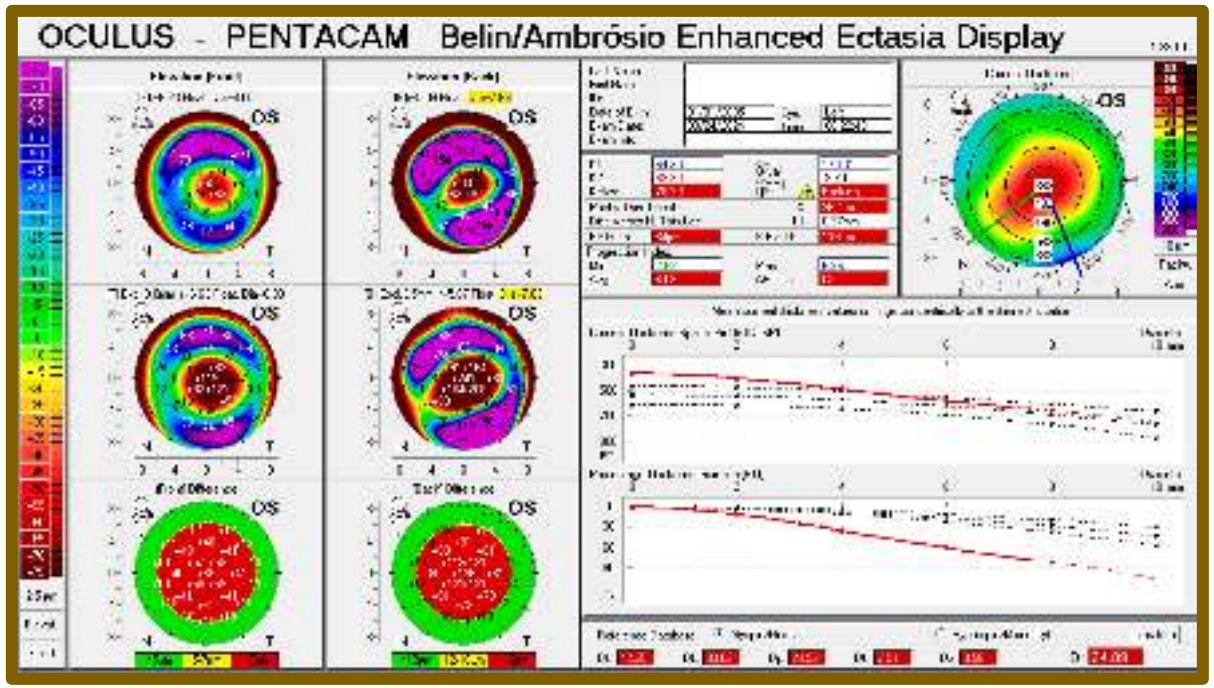
- 9 parameters in regression analysis
  - Each 9 parameters reported as a SD
    - Yellow at ≥ 1.6 SD
    - Red at ≥ 2.6 SD
  - Other parameters not used in regression formula also reported in SD
- Final “D” is an overall reading based on a proprietary regression formula.
  - **Final “D” is NOT A SD.**
    - Yellow at ≥ 1.6
    - Red at ≥ 3.0
      - Proprietary scale



Frequent Question: How do I interpret the BAD if I can't get a full 8.0 mm coverage

- Full coverage may be difficult (common) in;
  - Abnormal corneas (e.g. keratoconus)
  - Older patient with lid laxity
  - Asian population or individuals with smaller eyes/orbits
  - Poorly cooperative patients

How do I determine Keratoconus Progression if I can’t get a full 8.0 mm coverage



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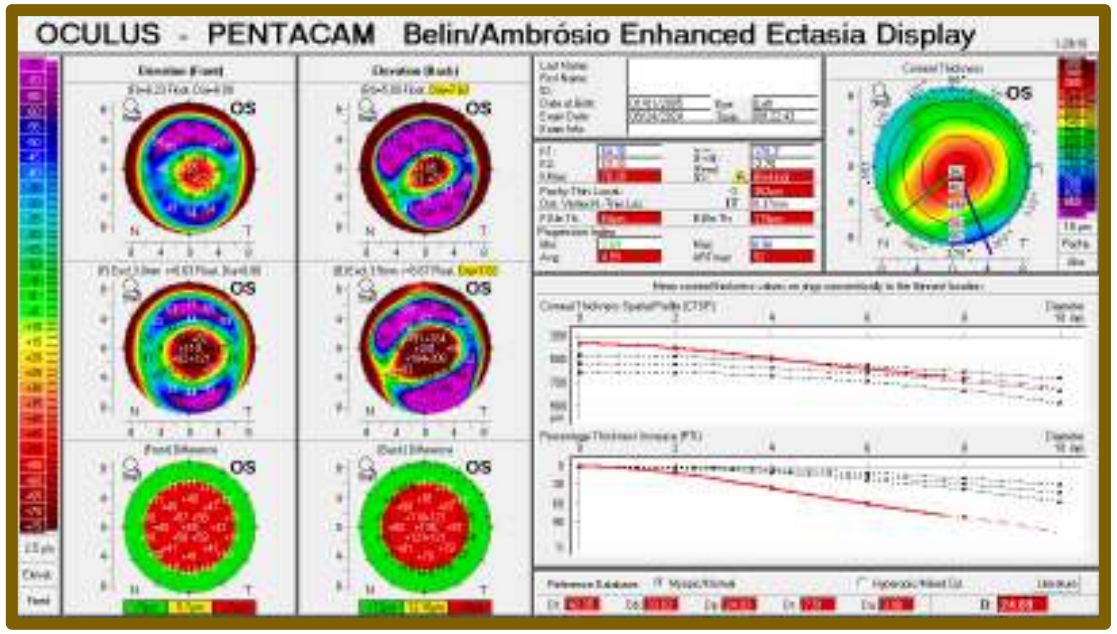
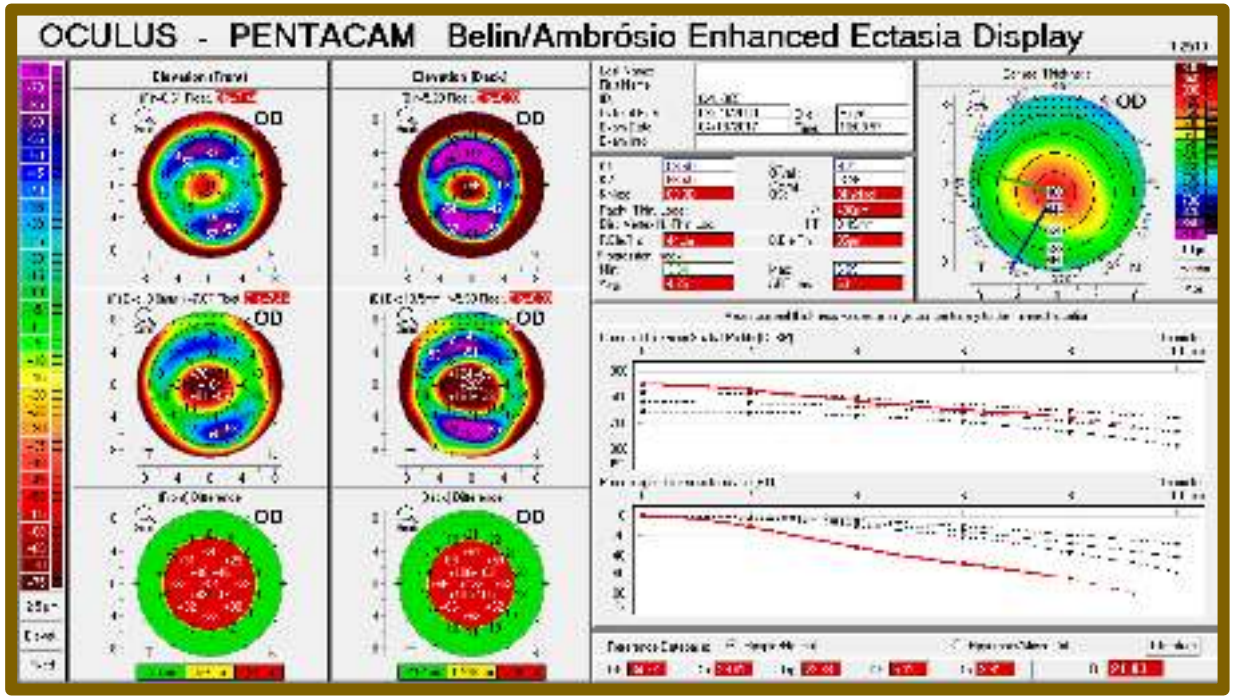


The Belin ABCD Progression Display uses a 3.0 mm optical zone (*not dependent on full coverage*) centered on the thinnest point

How do I interpret the BAD if I can't get a full 8.0 mm coverage: General Screening



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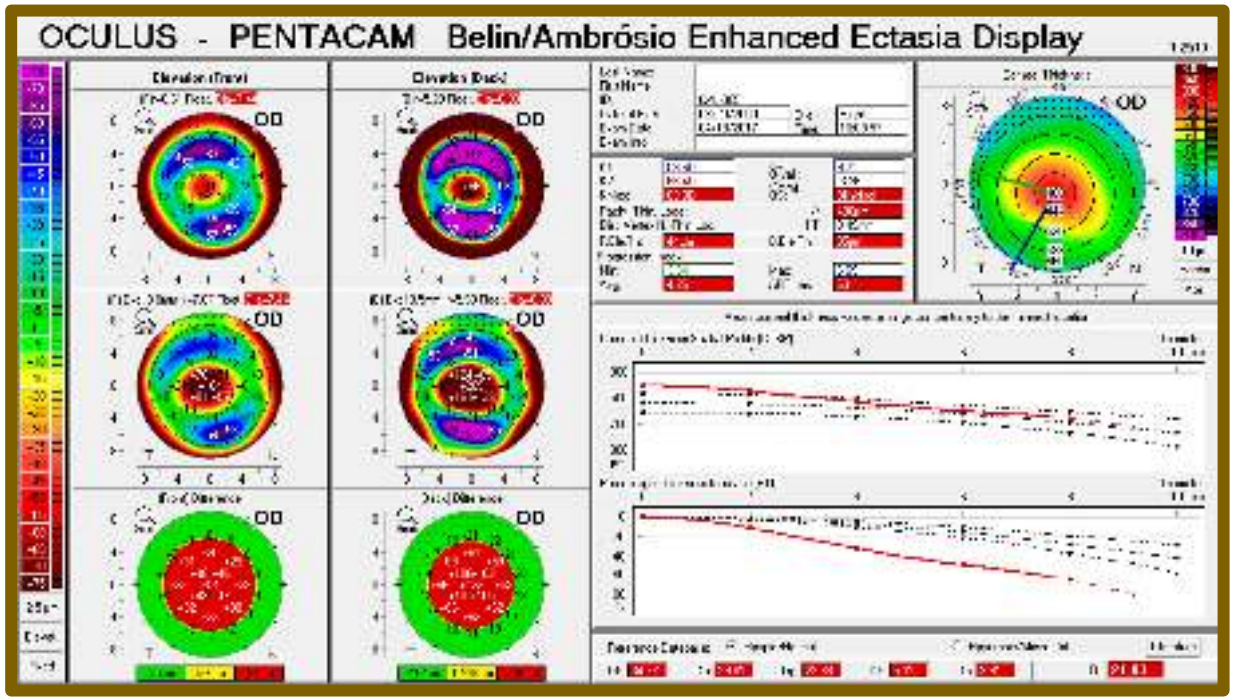
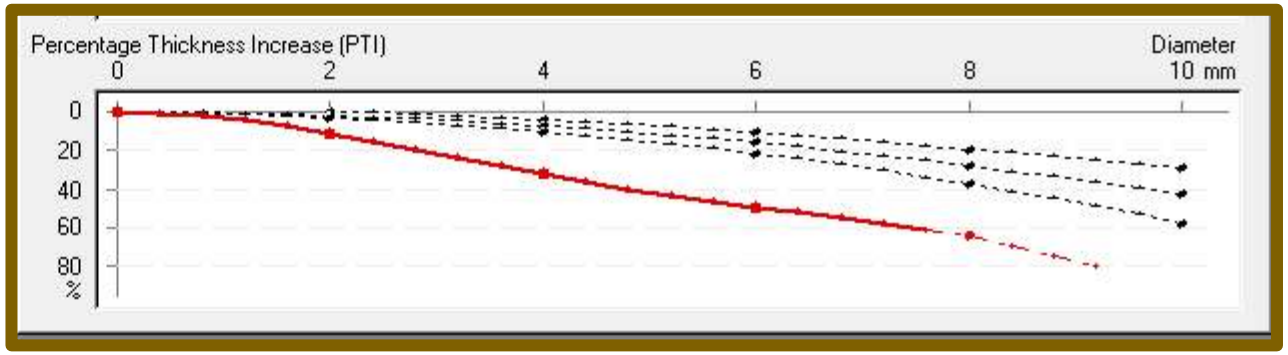
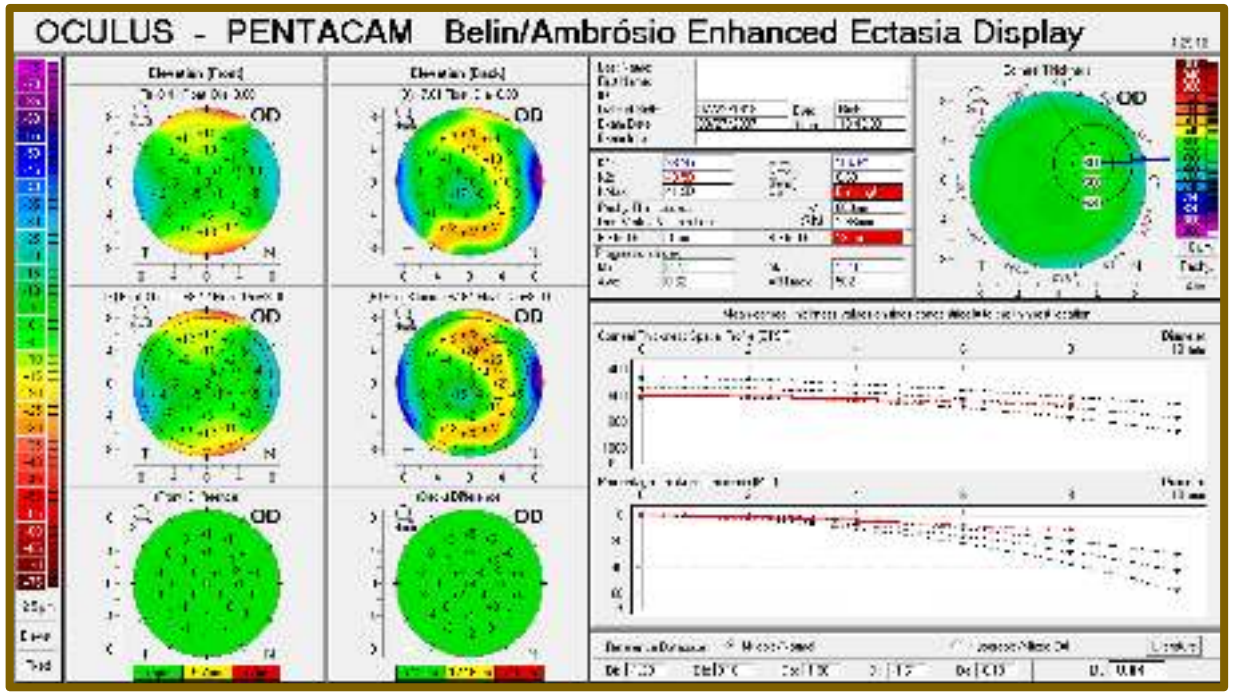
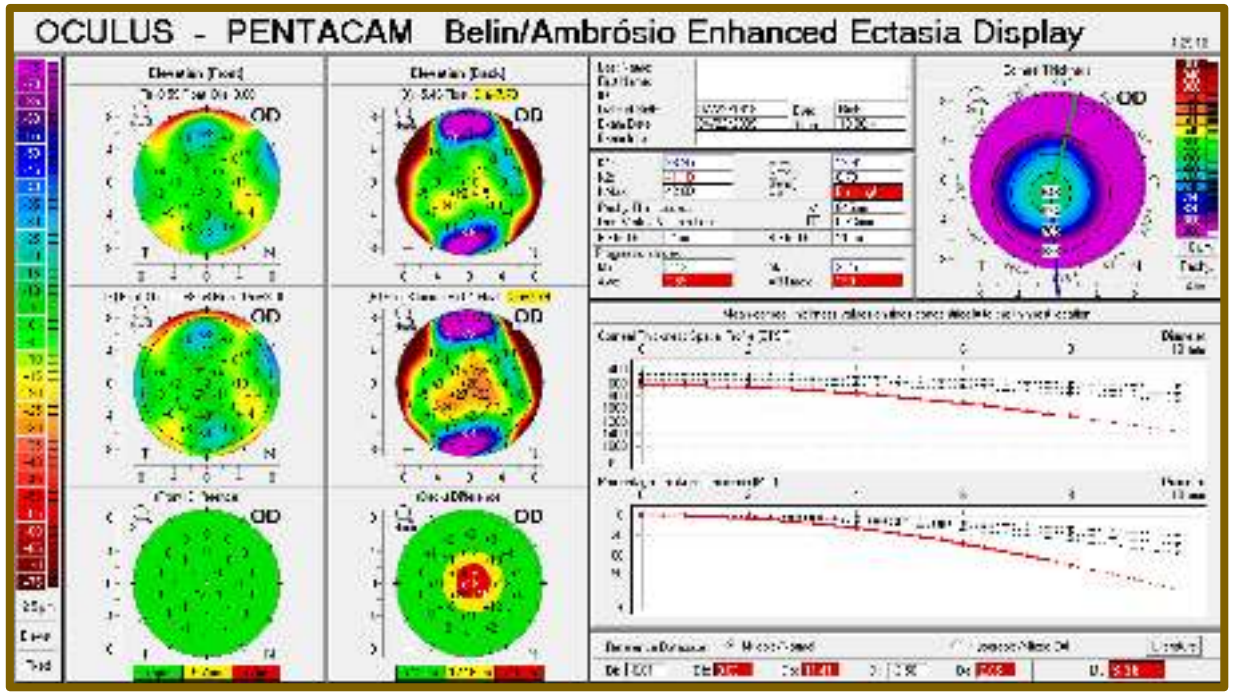




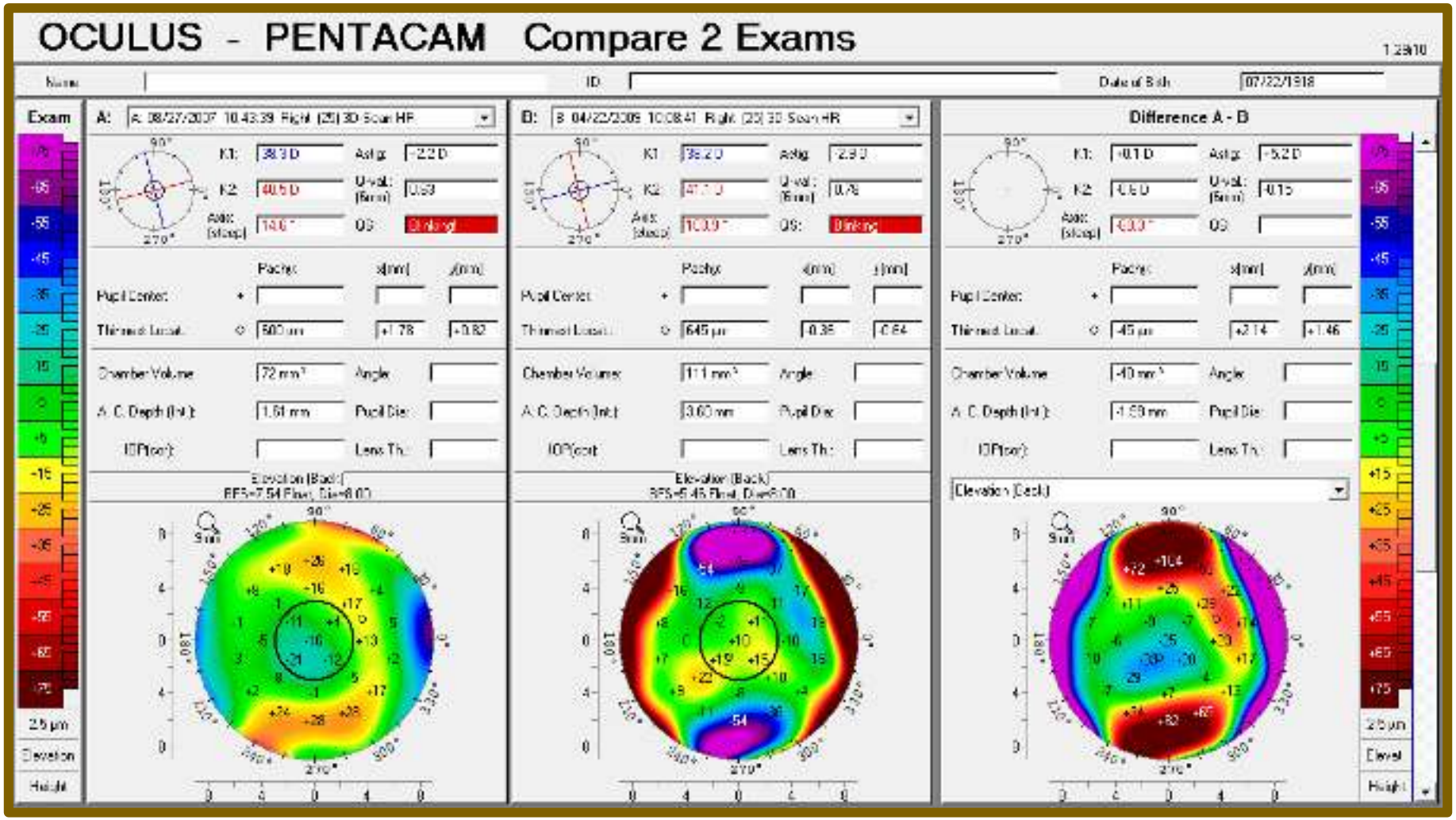
Look at the Pachymetric Progression Graphs
as these are accurate up to the area of coverage

How can I compare exams with different total coverage

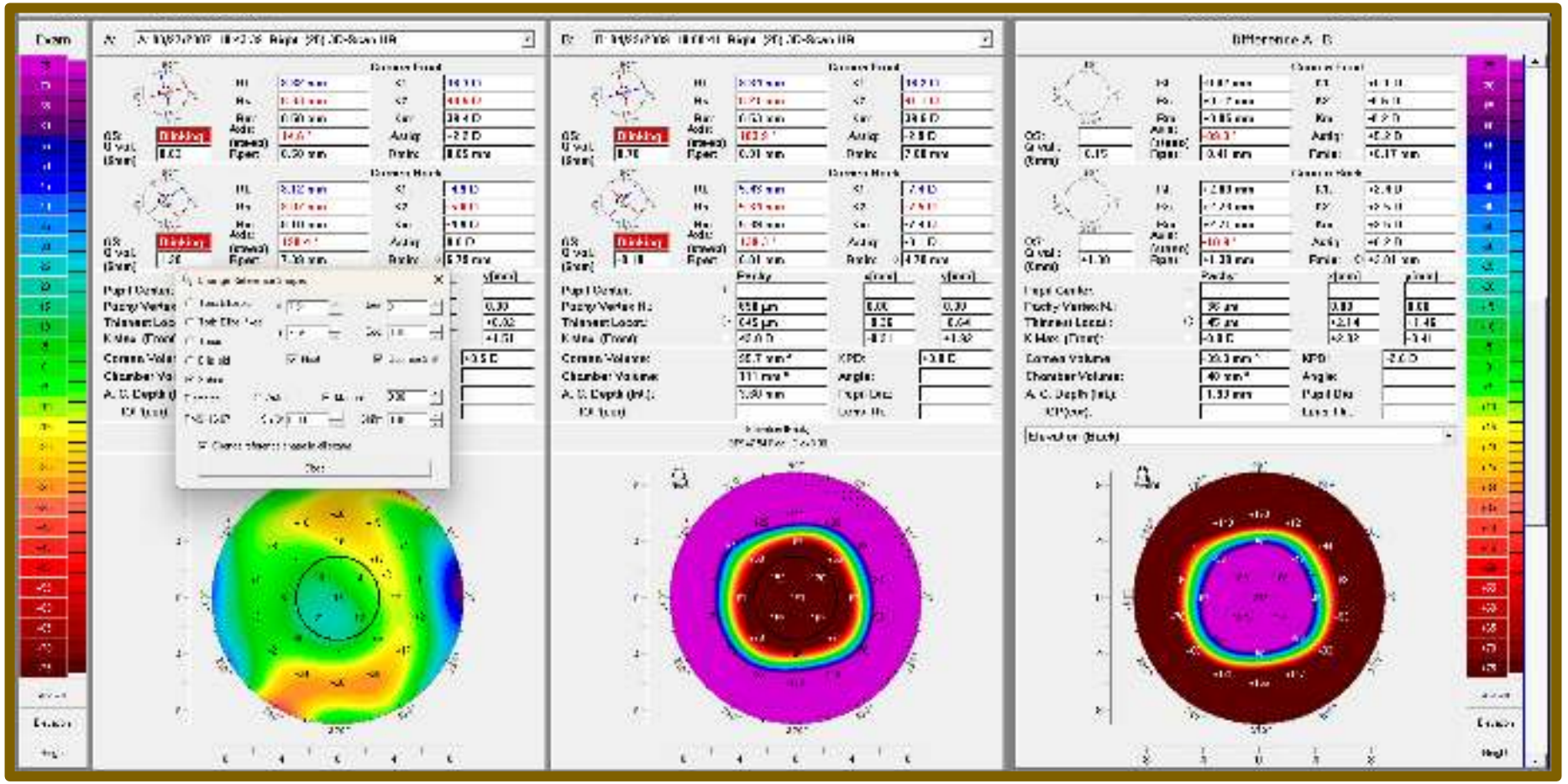




Use the Compare 2 Exams… BUT



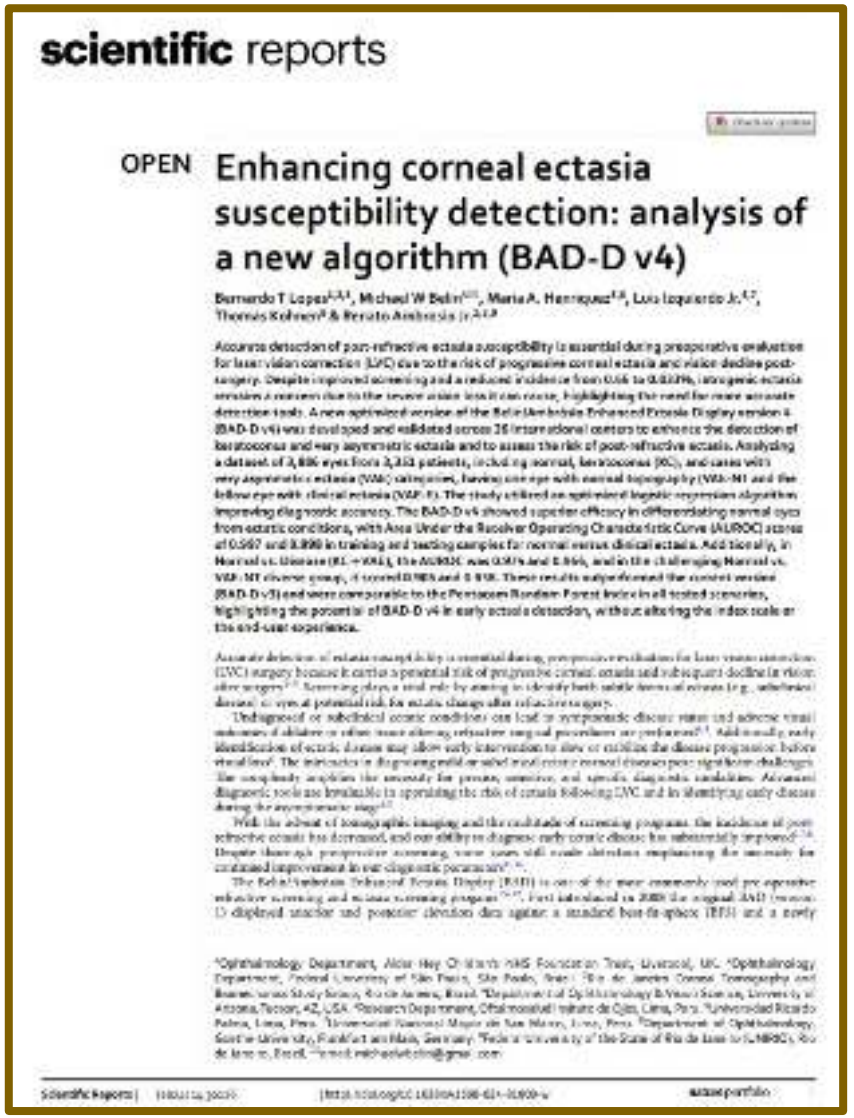
Compare 2 Exams - Use the dropdown menu to standardize the coverage



FORE / FOUR

What's New in BAD v4

- Database increased to 3,886 eyes from 26 different International sites
- Utilizes Optimized Logistic Regression Algorithm (*refined AI*)
  - Comparable to Random Forest Index
    - Discussed later
- Improved Diagnostic Accuracy



scientific reports

OPEN

Enhancing corneal ectasia susceptibility detection: analysis of a new algorithm (BAD-D v4)

What's New in BAD v4

- Database increased to 3,886 eyes from 26 different International sites
  - Evaluated 120 different parameters
    - Only 11 used in the Logistic Regression Analysis
      - Additional parameters did not improve performance

What's New in BAD v4

VARIABLE	DESCRIPTION
Age	**Age at time of exam**
Astigmatism	Cornea front surface astigmatism
BAD Dt	SD minimum corneal thickness
BAD Dy	SD mean vertical displacement of thinnest point
BAD De	SD mean cornea back elevation
RPI max	Maximum pachymetric progression
ART max	Maximum Ambrosio's relational thickness
RMS HOA (CB)	Root Mean Square HOA corneal back surface
RMS Z3-Z6 (CF)	Root Mean Square corneal front surface 3rd to 6th order
RMS Z3-Z6 (CB)	Root Mean Square corneal back suface 3rd to 6th order
Z (3,-J)	Measurement of total corneal vertical coma

Pentacam Random Forest Index (PRFI) *vs* Simpler Logistic Regression Analysis

- PRFI more complex
- Simpler Logistic Regression Analysis yielded similar / equal results
  - Equal AUROC
  - **Maintains the current BAD appearance**
    - **Same end-user experience**

BADv3 *versus* BADv4

Results of BAD Version 3 vs. BAD Version 4			
	Normal vs. Clinical Ectasia (KC + VAE-E)		
	AUROC	Sensitivity	Specificity
BAD V 3	0,994	96,30%	99
BAD V 4	**0,997**	**97,81%**	**99,17%**

Results of BAD Version 3 vs. BAD Version 4			
	Normal vs. Disease (KC + VAE-E, VAE-NT)		
	AUROC	Sensitivity	Specificity
BAD V 3	0,952	86,26%	94,72%
BAD V 4	**0,974**	**89,97%**	**96,70%**

BADv3 *versus* BADv4

Results of BAD Version 3 vs. BAD Version 4	
Separation between	Normal vs. VAE-NT

What are VAE-NT patients??

Patients who already have clinical ectasia in one eye but the other eye shows a normal topography.

The challenge for these patients is, to detect the ectasia in the eye with a normal topography

BAD V 3 BAD V 4

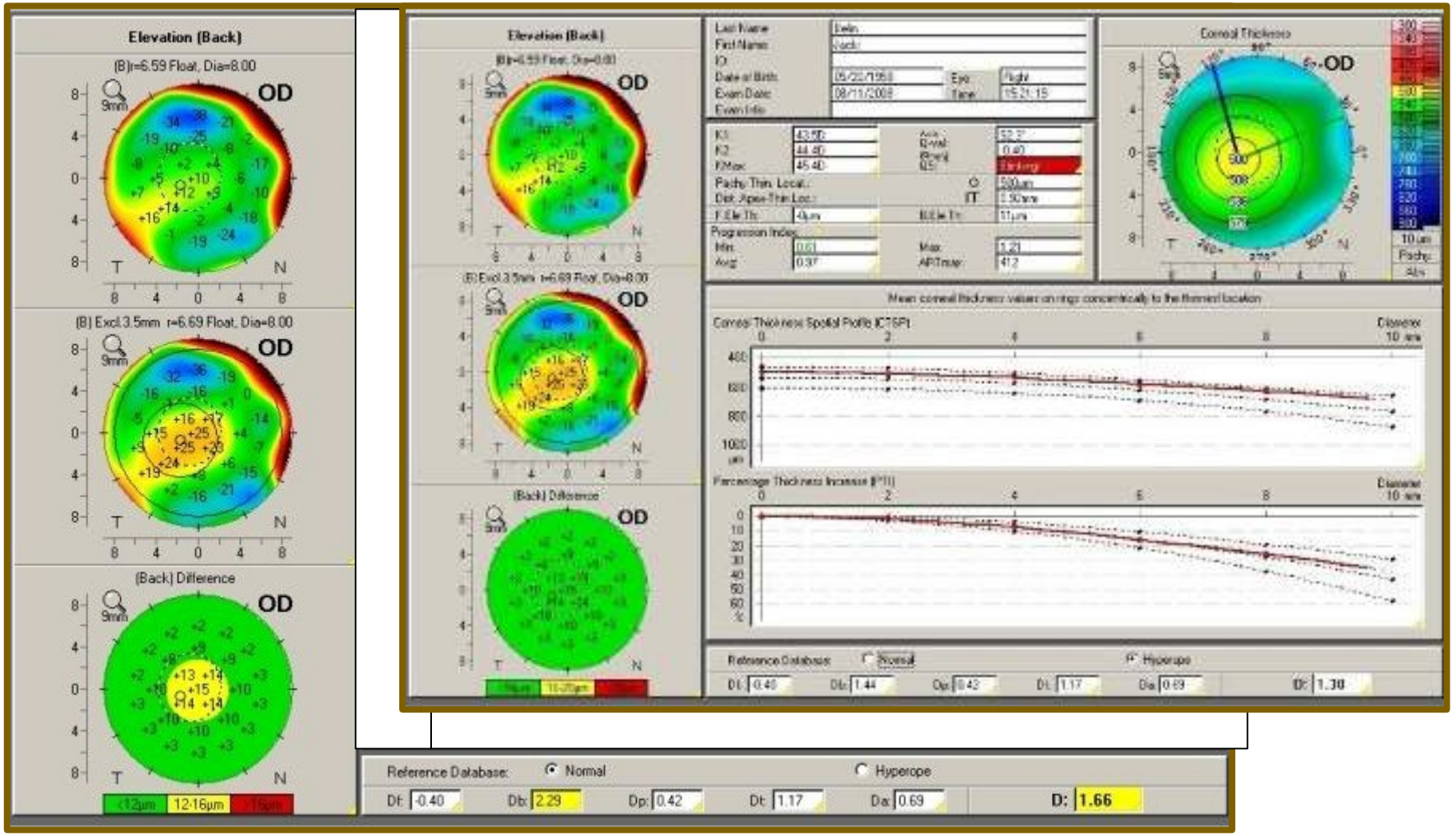
Greatest improvement for the most difficult cases of ~ 50%!

Pentacam® family

CXL

BAD v4 currently does not have Hyperopic/Mixed Cyl Database

- When you choose Hyperopic/Mixed Cyl in the BAD v4 it will utilize the prior BAD v3 program / analysis
- This is seamless and there is nothing the user needs to do.
- Should be addressed prior to final software release



As the end user, what changes will you notice going from BAD*v*3 to BAD*v*4


NONE

An overall improvement in performance, but with the same user interface (experience)

There have been multiple other proposed screening programs/displays but none have gained significant market penetration

Comparative Testing is difficult and often heavily biased

The Only Test that Really Matters

BAD display is the most commonly used Refractive Screening Program and has been since its introduction in 2008


Thank You