
Topography-Guided Custom Ablation in Irregular Astigmatism - Alternatives in fitting of the Targeted Surface and Dealing with the Remodeled Epithelium

Aleksandar Stojanovic, MD

University Hospital North Norway

SynsLaser Clinic, Tromsø and Oslo, Norway

Disclaimer

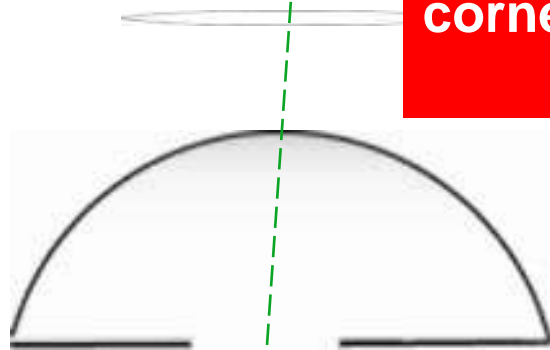
- ❖ No financial or proprietary interests in any of the products mentioned in the presentation
-

-
- 1. How to optimally fit the targeted surface and design an ablation that consumes the least amount of tissue and smoothly translates to the untreated cornea?
-

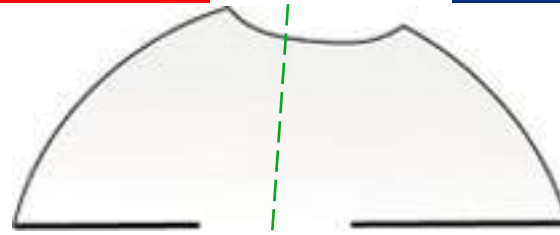


I.A. - decentered corneal optics

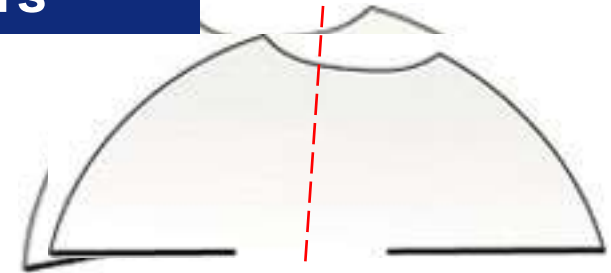
Neurovisual Adaptation occurs



Virgin cornea



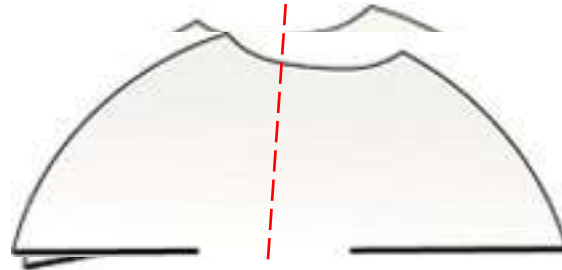
"View" through the original axis = visual distortion



Eye rotates and "finds" an "adapted" axis in order to lessen the distortion

What are our alternatives in treatment of IA?

□ A: **Correct the original mistake by re-identifying the original visual axis**—and then treat?

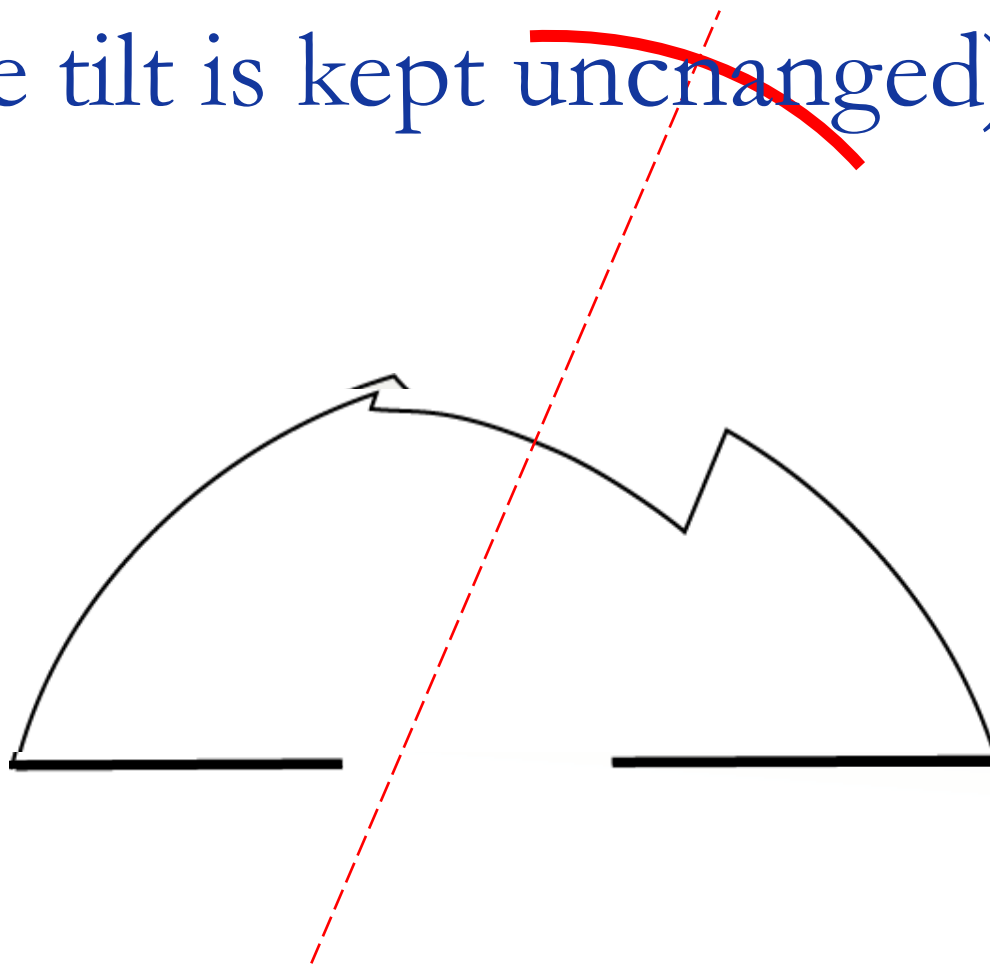


- B: **Treat on top of “the mistake”** and use the information referenced to a new “adapted” visual axis?
 - Topo (placido) or aberrometry information acquired by monocular exam is bound to the “secondary tilted” fixation axis

How does the treatment of IA, based on **Fixation Axis**, affect the cornea (if the tilt is kept unchanged):

Targeted surface perpendicular to the visual (fixation) axis results in:

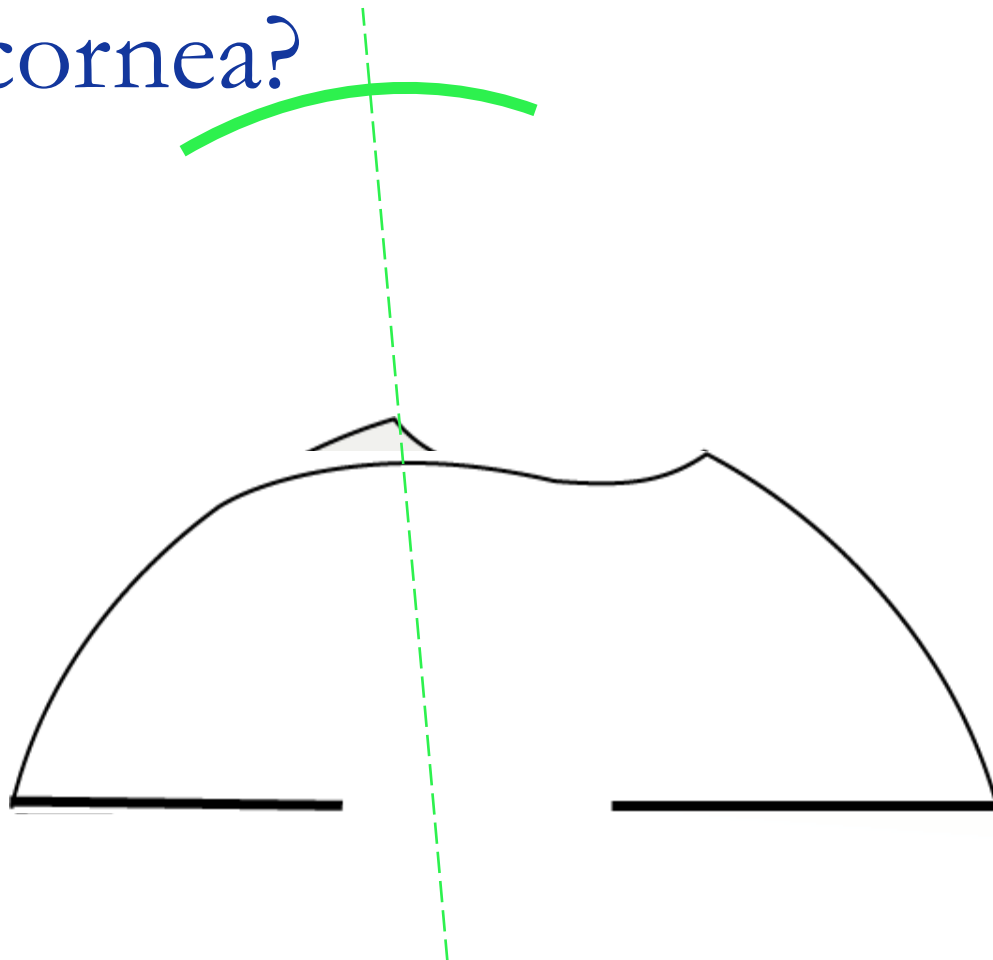
1. **Large tissue consumption**
2. Most of the ablation gets placed on the **already treated area**
3. Causes an **abrupt transition**



How to find the **Restored Morphological Axis** (iVIS)

- The topography information from the entire corneal surface (both the decentered and unaffected) is analyzed by software, along with the axial length of the eye
 - **Restored morphological axis** is generated
-

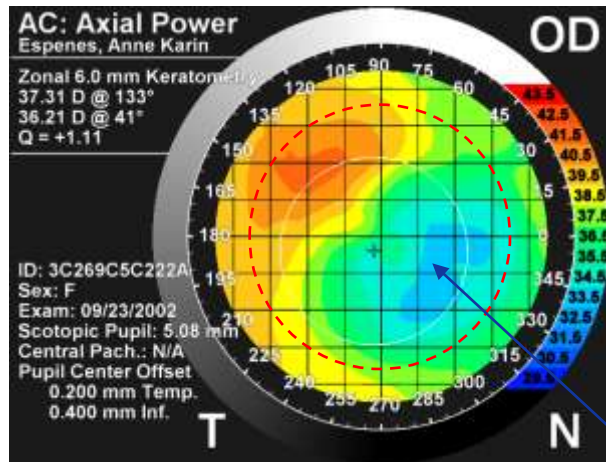
How does the treatment of IA, based on **Restored Morphological Axis**, affect the cornea?



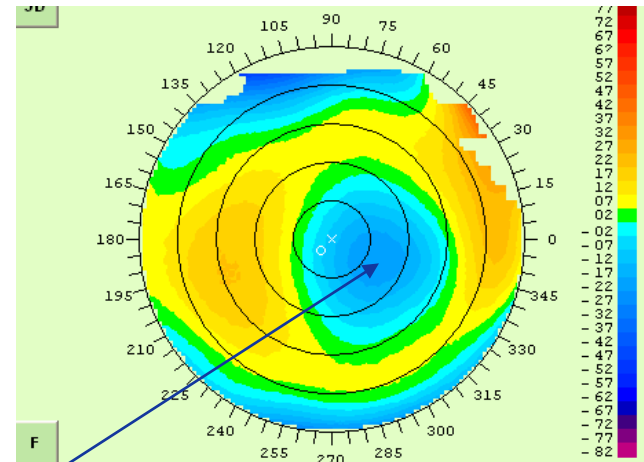
Targeted surface perpendicular to the morphological axis results in:

1. **Low tissue consumption**
2. Most of the ablation gets placed on the **previously untreated area**
3. Results in a **smoother transition**

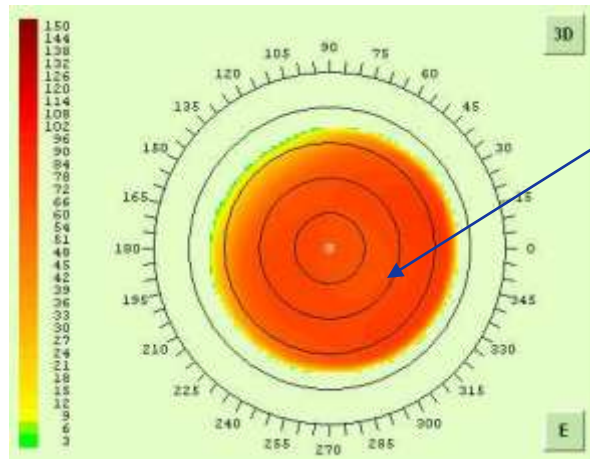
Visual Axis TGA (in decentered LASIK)



Preop. AstraMax axial keratometric map

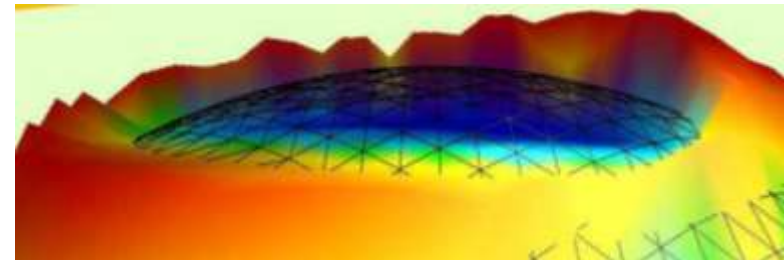


Preop. Orbscan floating elevation map



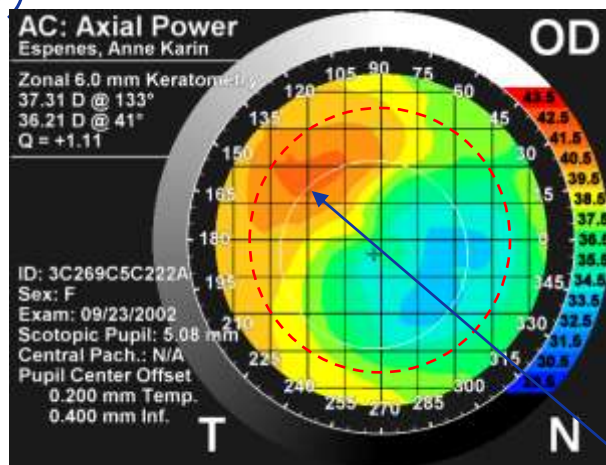
Max ablation depth 53 μ

The deepest ablation area

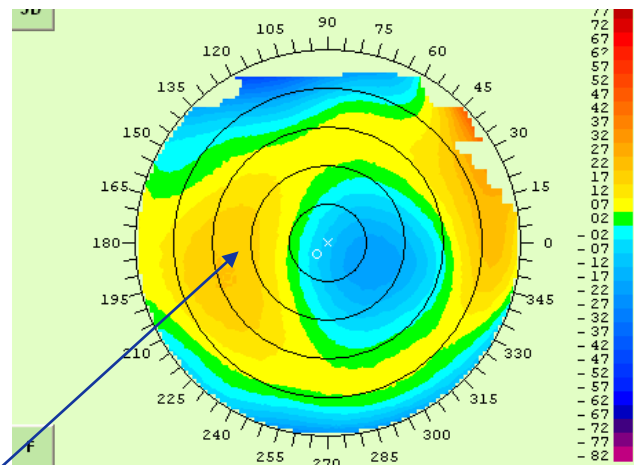


Simulated postop. floating elevation map
(Transition zone Δ elevation 96 μ)

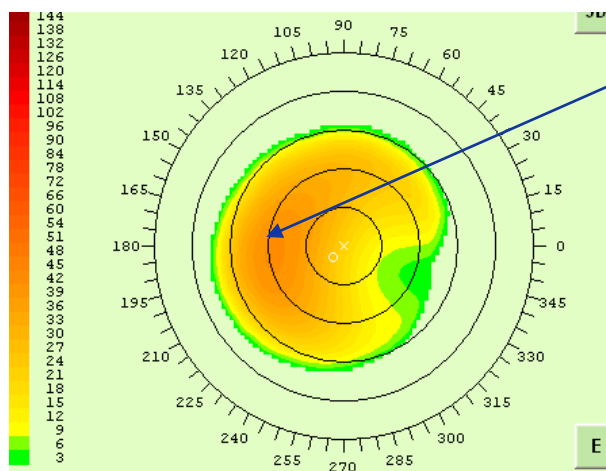
Restored morphological Axis TGA (the same case)



Preop. AstraMax axial keratometric map

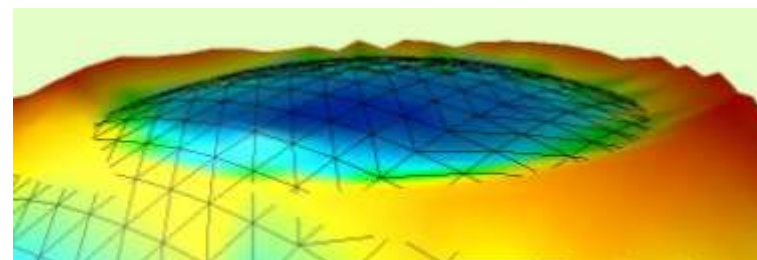


Preop. Orbscan floating elevation map



Max ablation depth 23 μ

The deepest ablation area



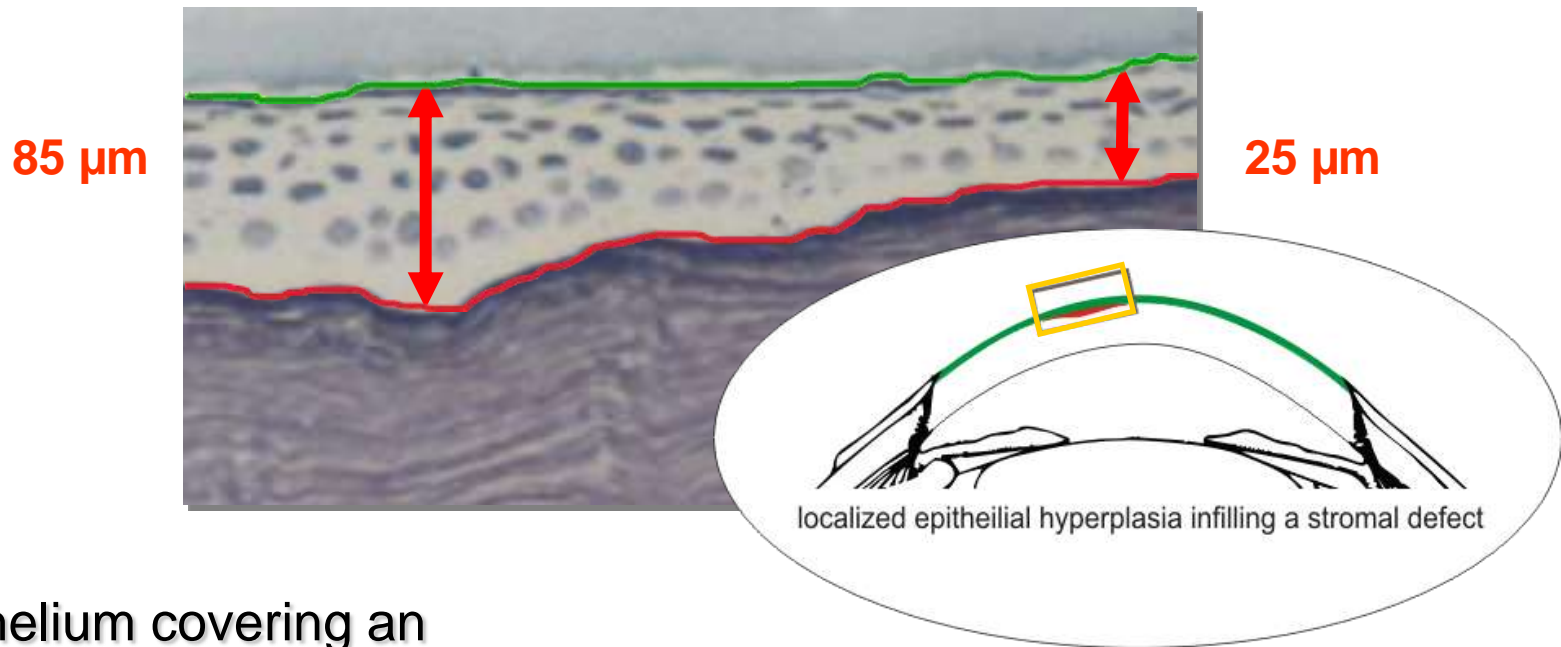
Simulated postop. floating elevation map
(Transition zone Δ elevation 14 μ)

Conclusion

- For CA of decentered optics - **Always compare the ablation map with the topography**
 - Make sure that the deepest point is not placed on the already treated area
 - Use "restored morphological axis" if available
 - Currently featured only by iVIS-Suite
 - **For other systems use the "tilt off" option**
-

2. How to deal with epithelium that has remodeled the corneal surface in IA?

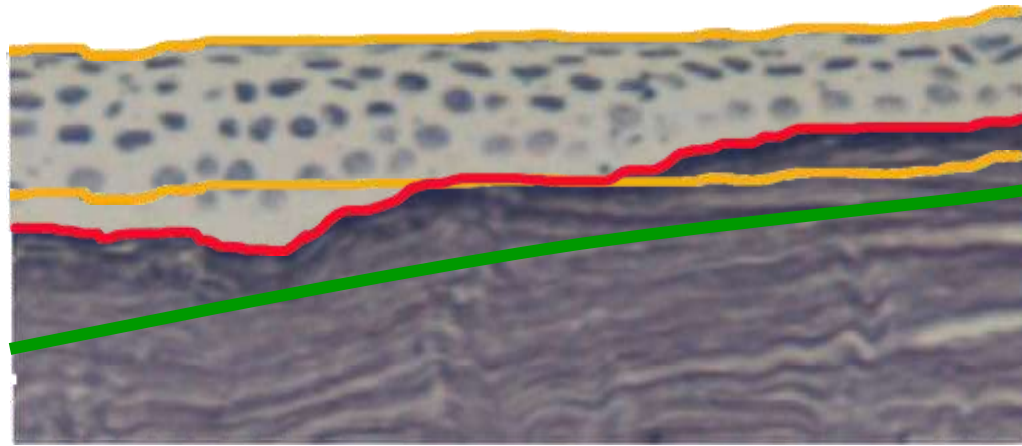
Variability of epithelial thickness - Due to remodeling in irregular astigmatism



- Epithelium covering an irregular stroma has a smoothing / filling characteristic
 - Grows thicker over depressions and thinner over elevations
- Morphology of the stromal surface under the epithelium may be very different from the morphology of the epithelial surface

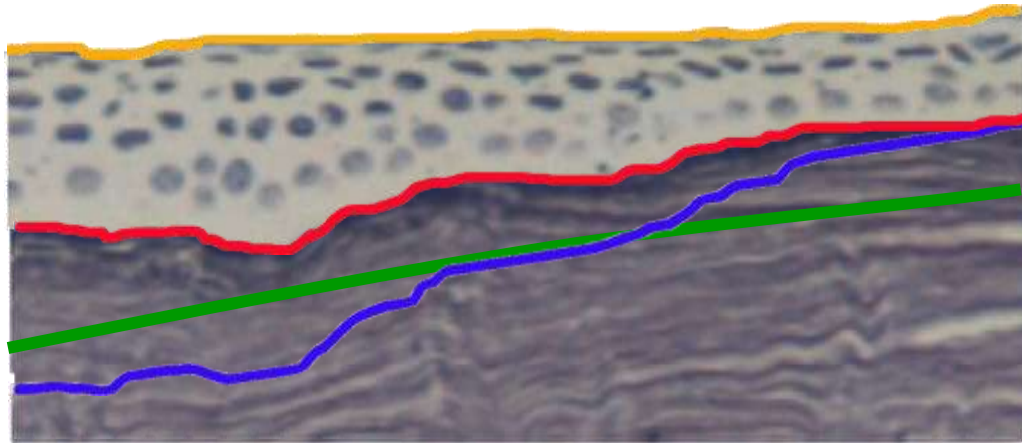
- But the optics and topography of the epithelial surface is the basis of our custom ablation planning

Variability of epithelial thickness - a problem in custom surface ablation



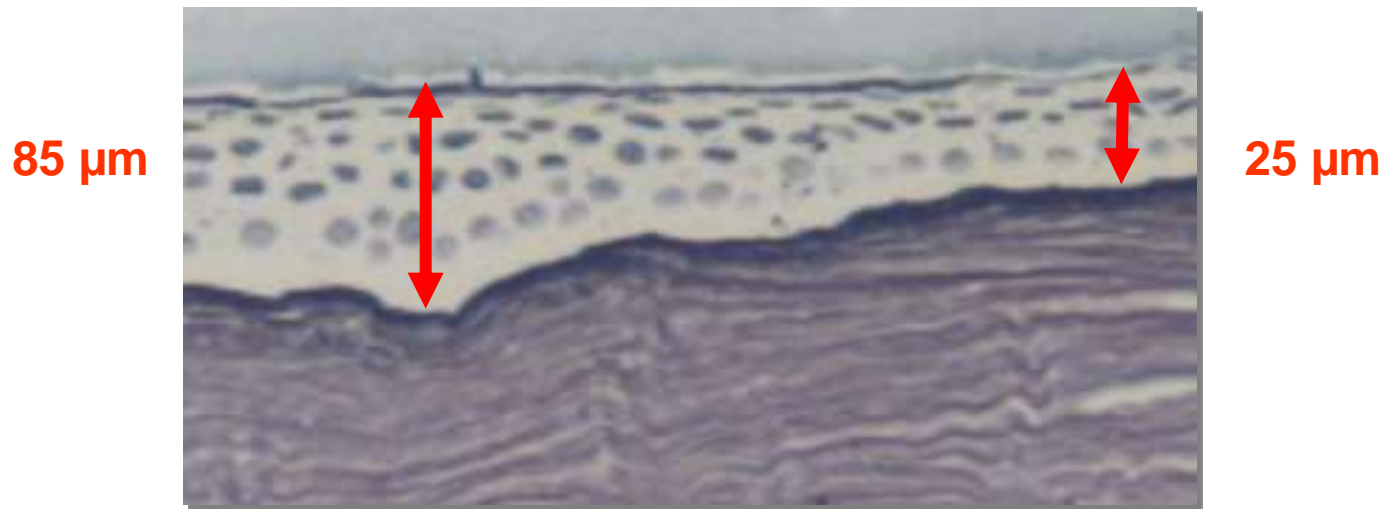
- Custom surface ablation (PRK, LASEK, EpiLASIK...) that involves epithelial removal
- **Must assume** the stromal surface mirrors the epithelial surface, i.e. **that the epithelium is of uniform thickness**
 - If we expect to achieve the desired corneal shape-change on the basis of custom data acquired with the epithelium still covering the cornea

Variability of epithelial thickness - a problem in custom surface ablation



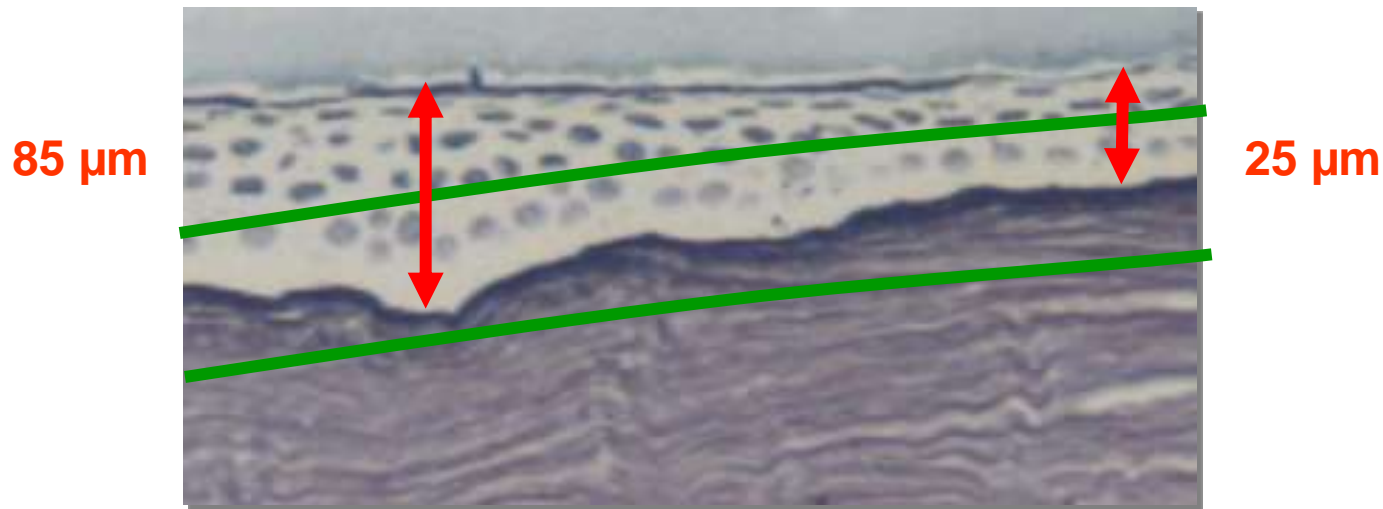
- In reality, epithelial removal in an irregular cornea will uncover an unmeasured irregular stromal surface
- Furthermore the custom ablation applied to this surface, will induce new major irregularities
- Resulting in an outcome quite different from the desired

Solution A: epithelium may be removed mechanically, alcochol... if:



- The epithelium thickness **can be mapped** (Artemis, hi-res OCT?) and the custom ablation plan may be modified accordingly, taking into account the uneven epithelial thickness
- This requires not only the accurate measurements but also registration w.r.t. the ablation plan
 - No commercially available interface between the measuring devices and the custom ablation systems

Solution B (cTEN by iVIS):



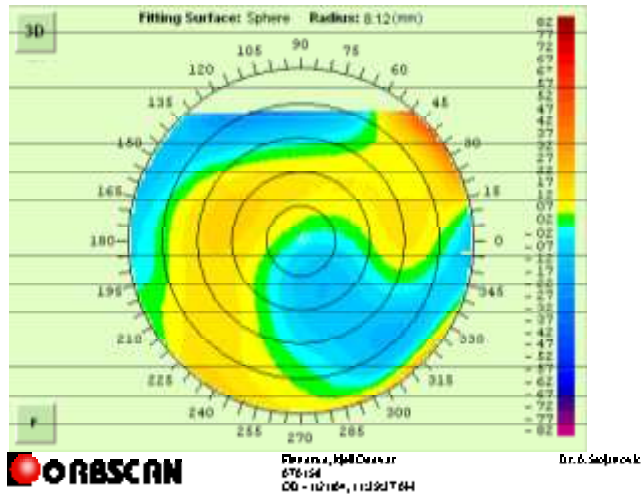
- Epithelium is removed with laser, together with stroma
 - Epithelial removal being an integral part of a single ablation, circumventing the whole problem of the “unknown” stromal surface
- The desired postoperative surface is simply moved below the epithelium into the stroma, by means of a lamellar ablation, which is seamlessly added to the custom ablation plan

Clinical study

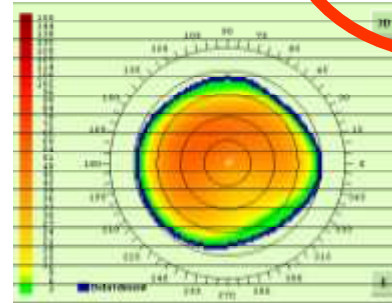
- Ongoing prospective study
 - Treatment of 100 eyes of 100 patients with visual disturbances due to secondary irregular astigmatism (after previous refractive and other eye surgery, injuries or keratitis)
 - The first treatments done in March 2002
 - **80 eyes** reached minimum 24 months after surgery
-

Clinical outcomes

Irregular astigmatism after decentered LASIK

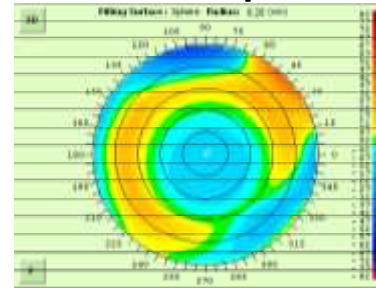


UCVA	SPH	CYL	AXES	BSCVA	ASPH	Sc.PUP
20/100	-1.00	-1.25	98	20/30	+0.98	5.8

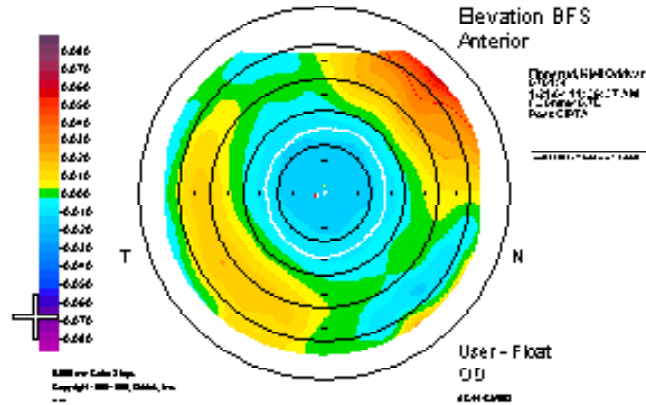


Multiplopia, glare, haloes

Ablation plan



Simulated outcome



Postoperative 12 M.

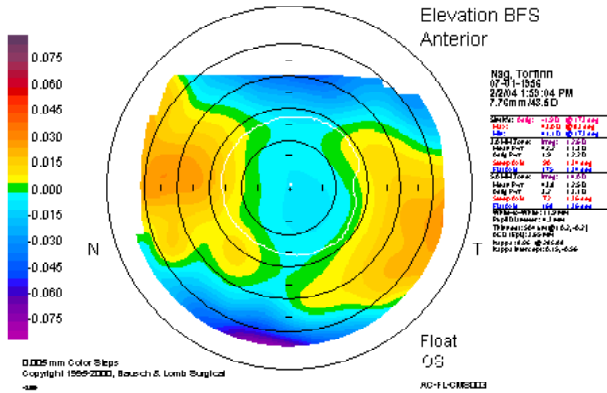
UCVA	SPH	CYL	AXES	BSCVA	ASPH
20/25	+0.25	-0.75	85	20/20	+0.19

Irregular astigmatism and very oblate asphericity after RK

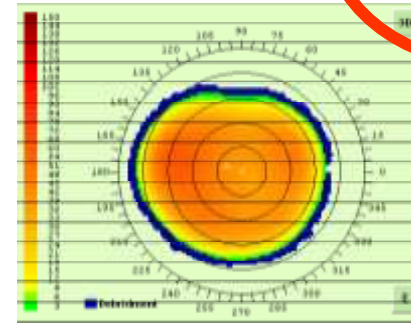


Nag, Torfinn
07-01-1956
03 - 2/2/04, 1:59:04 PM

Aleksandar Stojanovic
SynLaser Consult AS
+47 770 47920



UCVA	+0.25	CYL	AXES	BSCVA	ASPH	Sc.PUP
20/60	+1.00	-2.00	143	20/30	+1.45	6.0



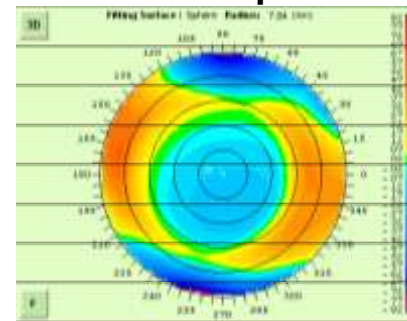
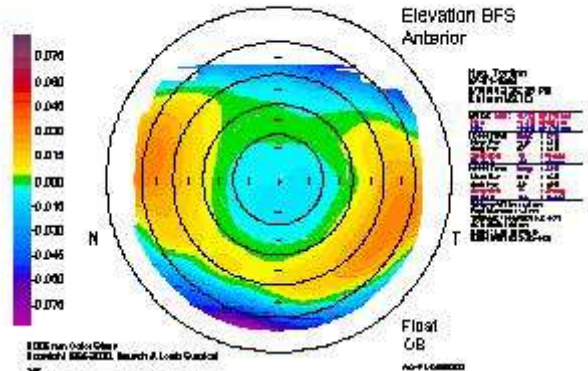
Glare, haloes,
Night vision
disturbances

Preoperative



Nag, Torfinn
07-01-1956
05 - 6/10/04, 2:26:28 PM

Aleksandar Stojanovic
SynLaser Consult AS
+47 770 47920



Postoperative 12 M.

UCVA	SPH	CYL	AXES	BSCVA	ASPH
20/25	+0.25	-0.75	125	20/20	+0.18

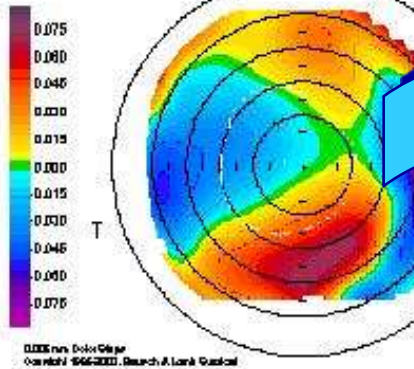
Irregular astigmatism after PK



Fornalba, Mirjan
08-09-1992
00 - 2/18/04, 3:20:27 PM

Mikozander Stojanovic
Bynolaser, Consult. AS
+47 778 47620

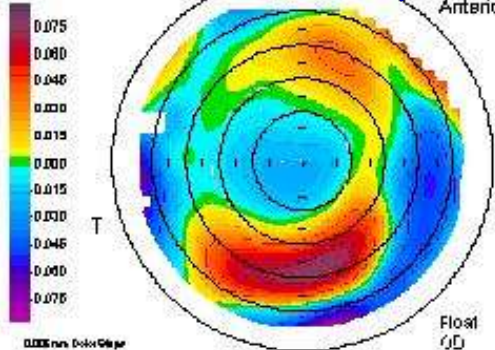
Elevation BFS
Anterior



Preoperative

Fornalba, Mirjan
08-09-1992
00 - 4/2/04, 3:22:00 PM

Anterior



Postoperative 12 M.

UCVA	SPH	CYL	AXES	BSCVA	ASPH	Sc.PUP
20/1000	-2.5	-9.00	95	20/40	+0.87	5.0

Thank you

Multiplopia,
Glare, haloes,
Night vision
disturbances



Simulated outcome

UCVA	SPH	CYL	AXES	BSCVA	ASPH
20/40	+0.25	-1.25	175	20/25	+0.05