

# Corneal hydrostatic pressure & Aspiration of Fluid and Debris into the LASIK Interface

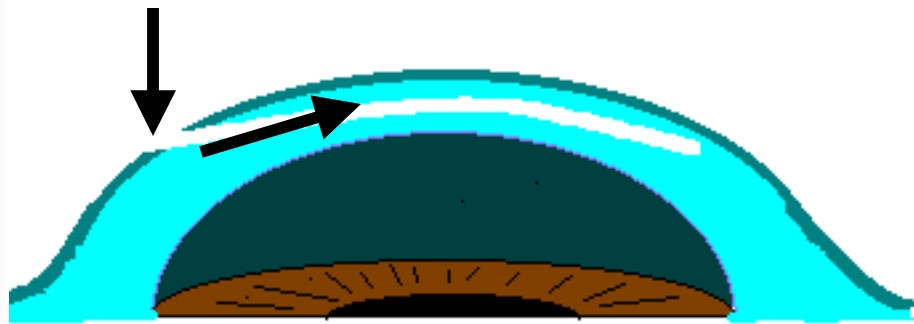


# **Highlights of the American Society of Cataract and Refractive Surgeons, 1999 Annual Meeting.**

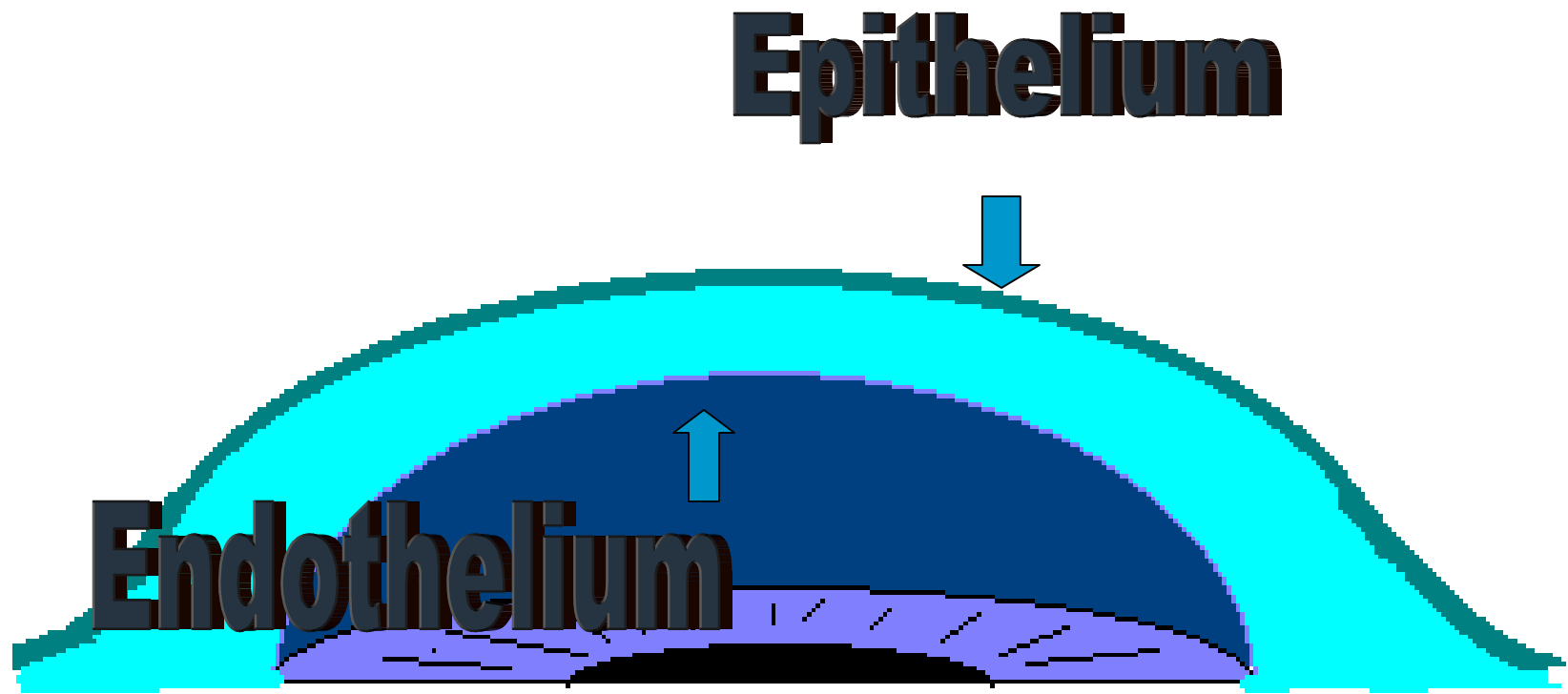
Boston:Ophthalmology Interactive;1999.  
[CD-ROM]

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# “Stromal Suction Model”



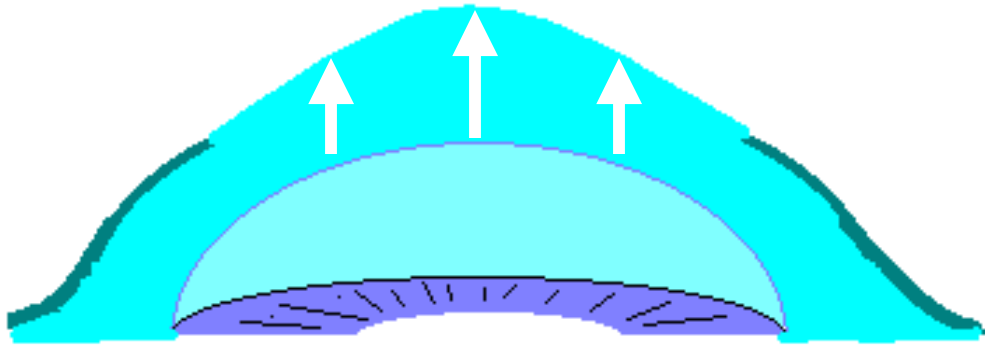
- Fluid and debris is actively aspirated into the LASIK interface and corneal stroma **after** LASIK surgery **until** the epithelial barrier is intact
- Important to etiology of DLK, interface debris and topographic abnormalities



The normal cornea exists in a dehydrated state maintained by the epithelium and endothelium

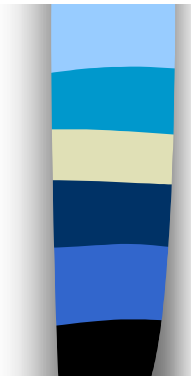


# Stromal Suction

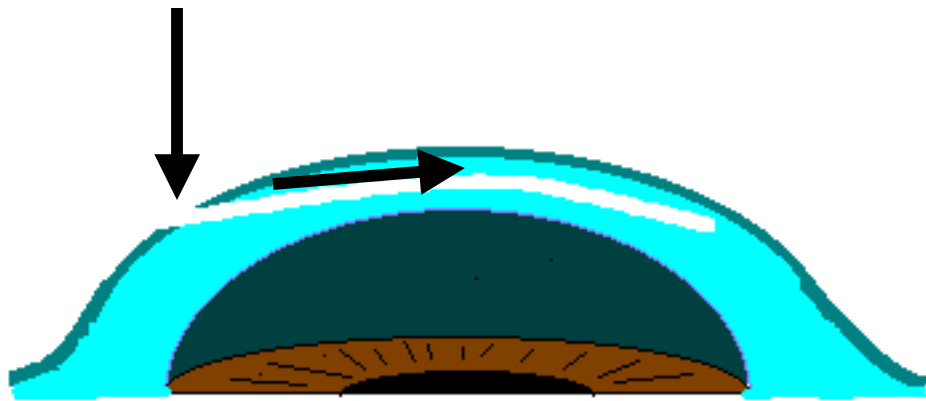


## ■ Corneal Swelling Pressure

- relative dehydration of the stroma

- **Central cornea swells more** than the peripheral cornea when placed in water
  - **Attracts fluid into the central cornea**
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# Epithelial Defect



- Lasik creates a circular epithelial defect ( gutter) confluent with the **potential space** in the Lasik interface

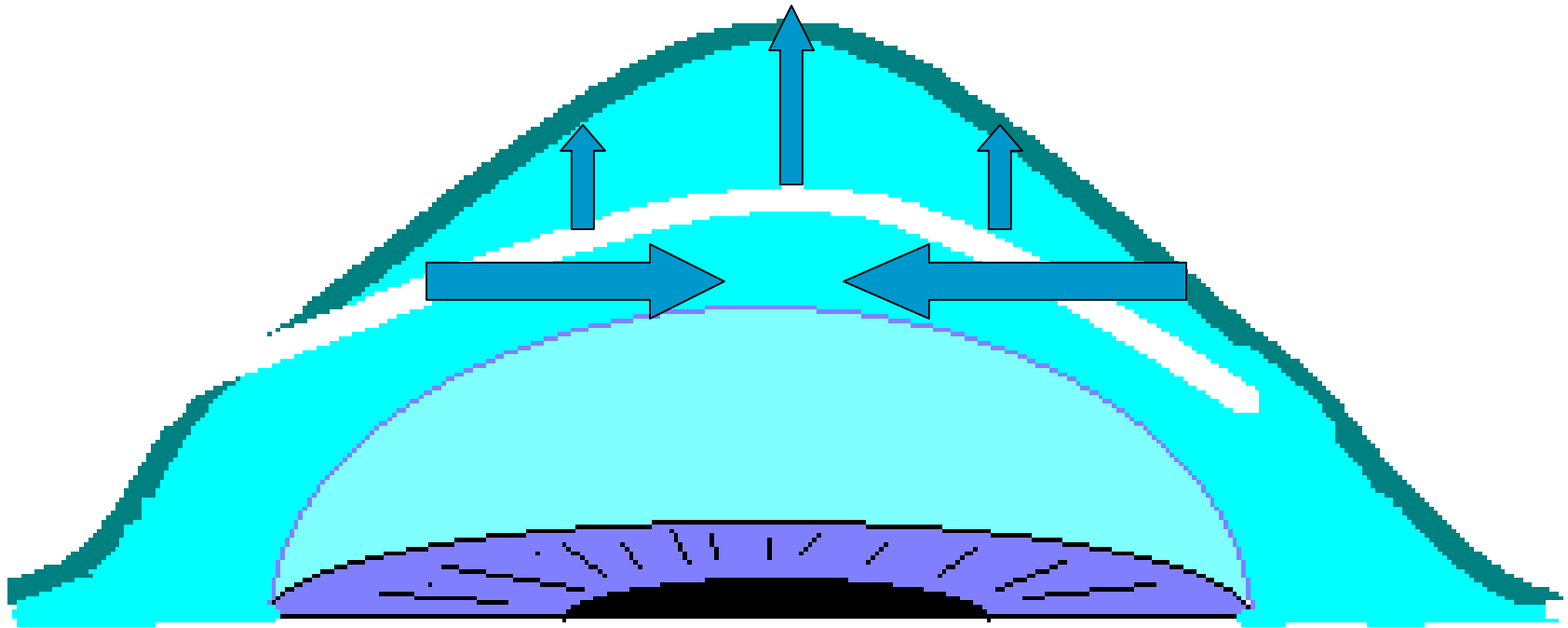
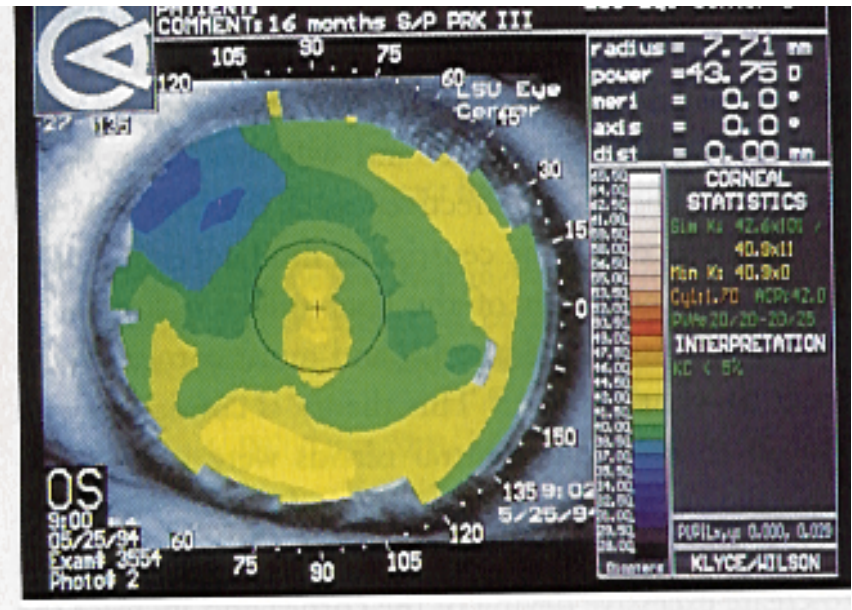
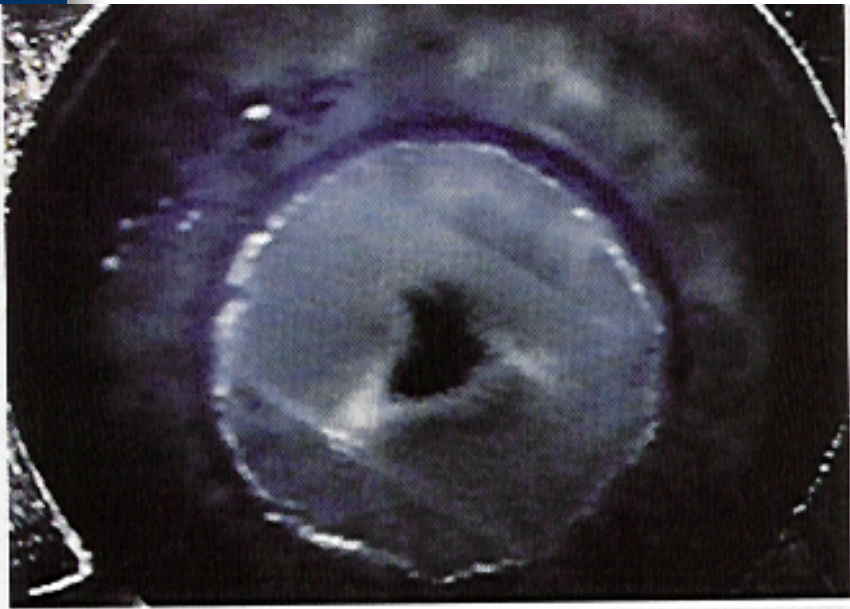


Figure 4

The corneal swelling pressure draws fluid and debris into the Lasik interface. The swelling pressure is greatest centrally and draws fluid and debris into the central cornea (thereby creating central islands).

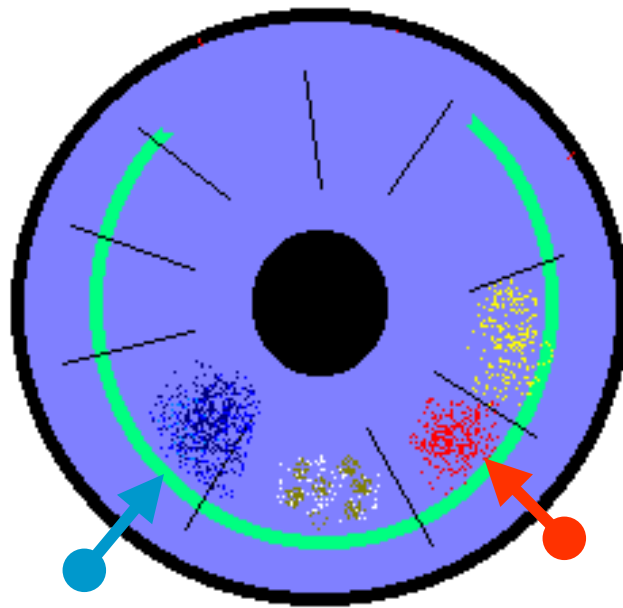
# Central island

## Central fluid buildup with laser





# Immediately after surgery



- Corneal edema
- Denatured superficial epithelium desquamates as a fine cellular debris
- Small pieces of debris attach to the gutter (most eventually move with repeat blinking)

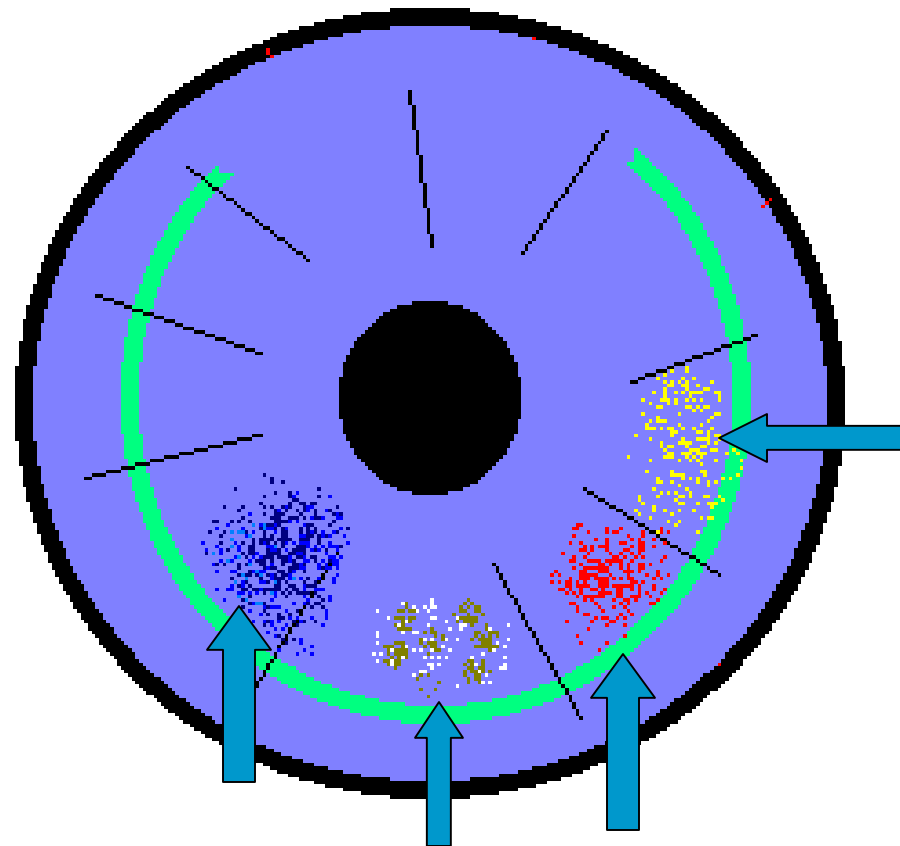
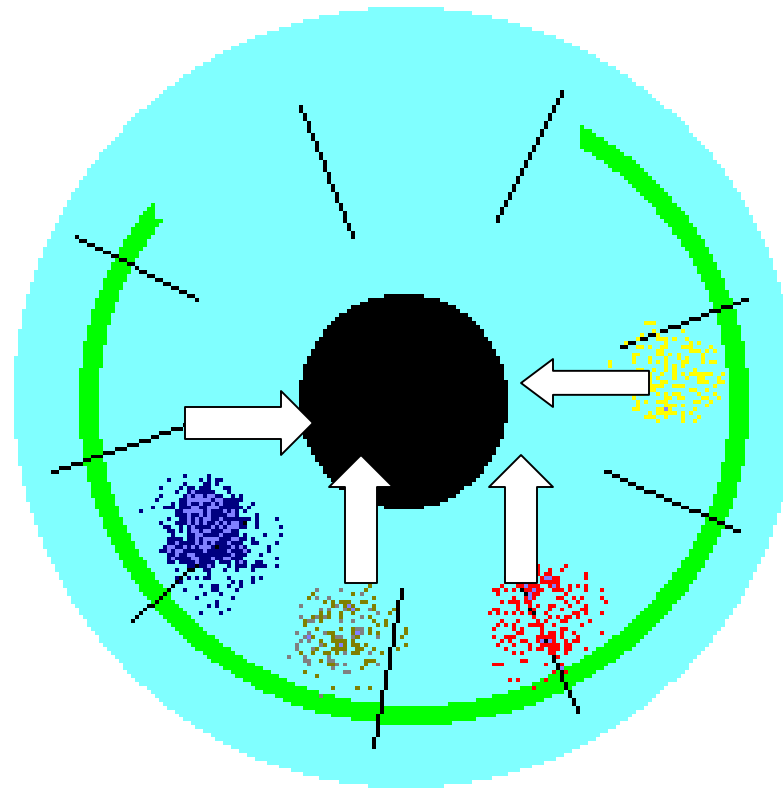


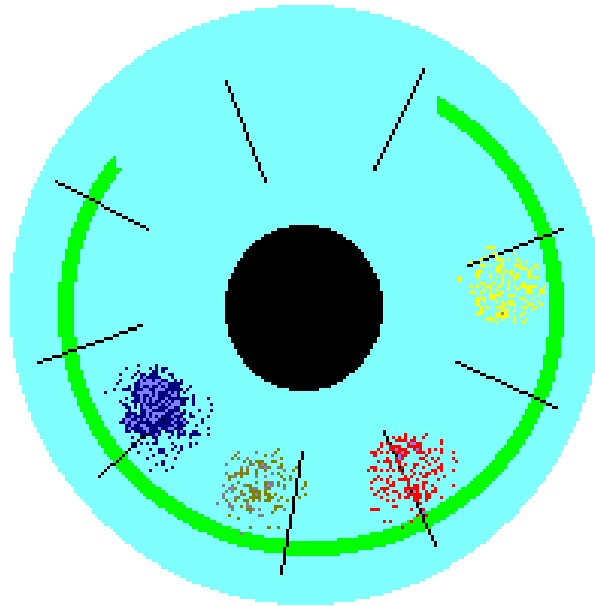
Figure 1

Until the epithelium is intact debris and fluid are actively aspirated into LASIK gutter and the potential space in the LASIK interface



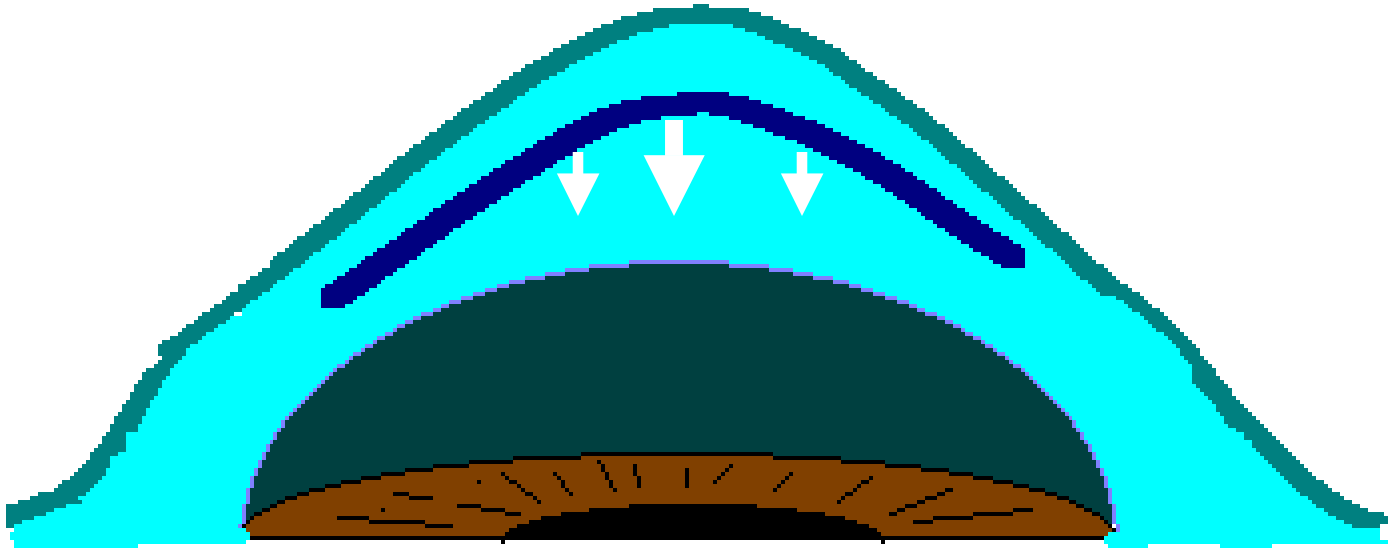
**Figure 6** (Johnston) Peripheral debris and fluid are drawn towards the central cornea by the higher central corneal swelling pressure.

# Post-Op Observations



- Debris in the interface may appear between the immediate post-op exam and a subsequent exam
- Interface debris is more often noted in the peripheral interface

# Microstria Formation



**Figure 7.** (Johnston)

When the epithelium heals, the cornea dehydrates and the excess flap tissue infolds with secondary microstria of the cornea.

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# Case 1

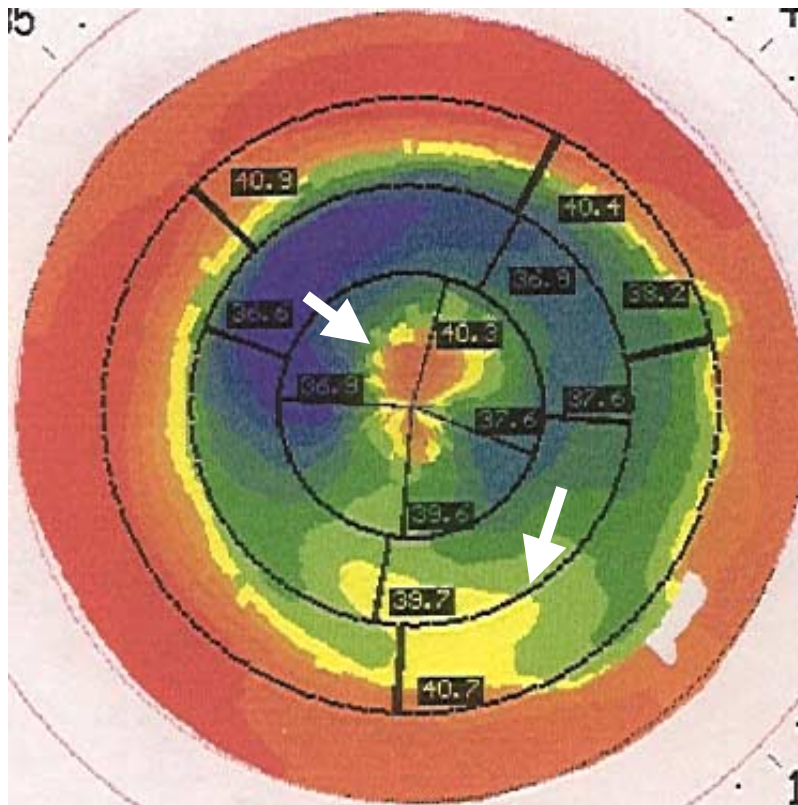
## Day 1

- Debris on lower lid
- Interface debris similar to the debris on lids
- ? Stage I DLK

## Day 3

- Complains of mild discomfort and deterioration of vision
- Debris now distributed throughout the interface
- ? Stage 3 DLK

# Case 1- Day 19



- Central Island with an inferior peninsula
- Topography consistent with inferior aspiration of fluid and debris into the inferior interface before the epithelium in the gutter was healed
- Topography consistent with increased corneal swelling and aspiration into the central cornea



## Case 2

- Hansatome 9.5 mm plate
- Bleeding noted at the edge of the keratectomy at surgery
- Vision worse at day 3
- Mild RBC's noted in the peripheral interface
- Mild peninsula originating at the area of bleeding



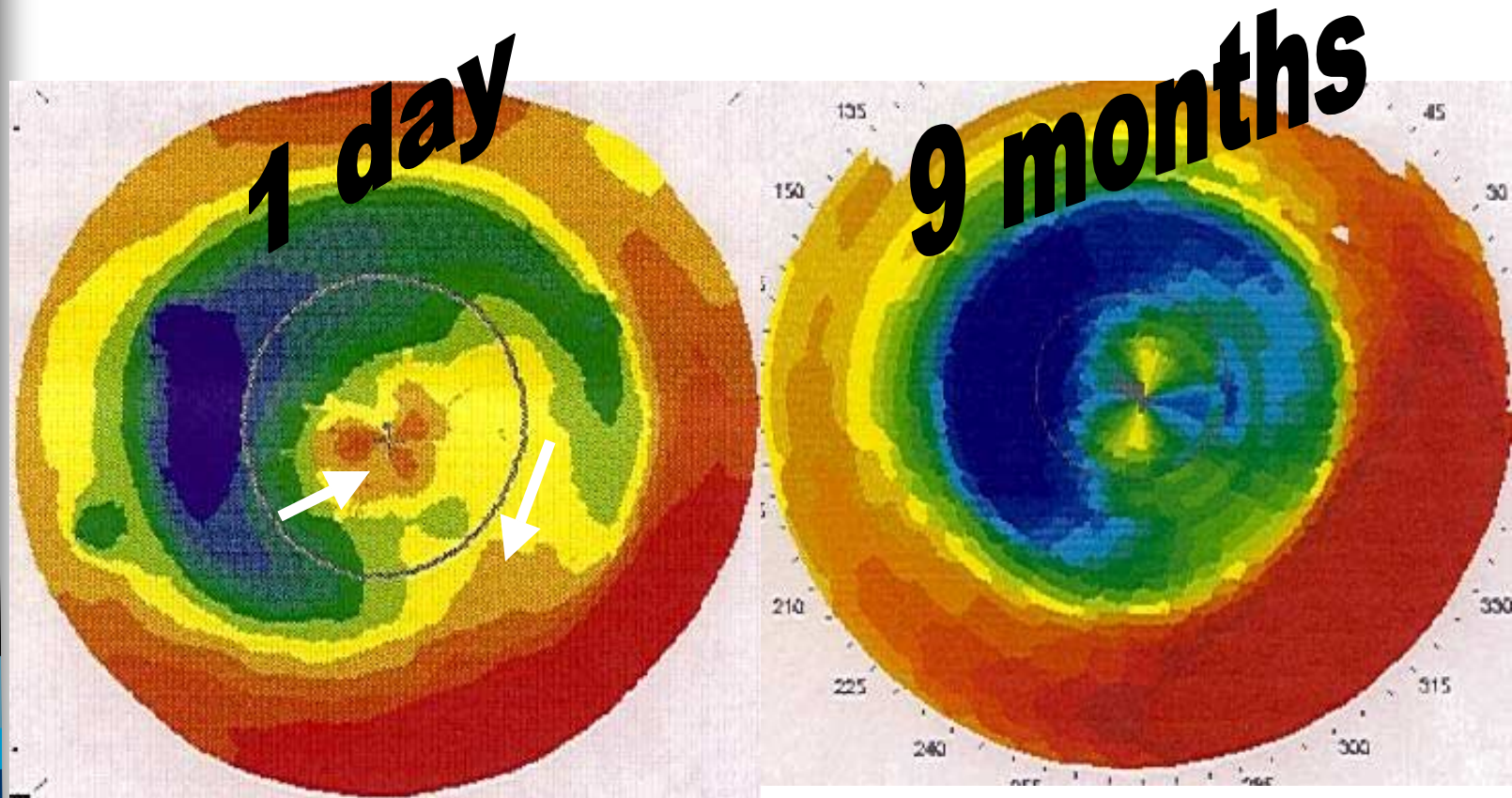


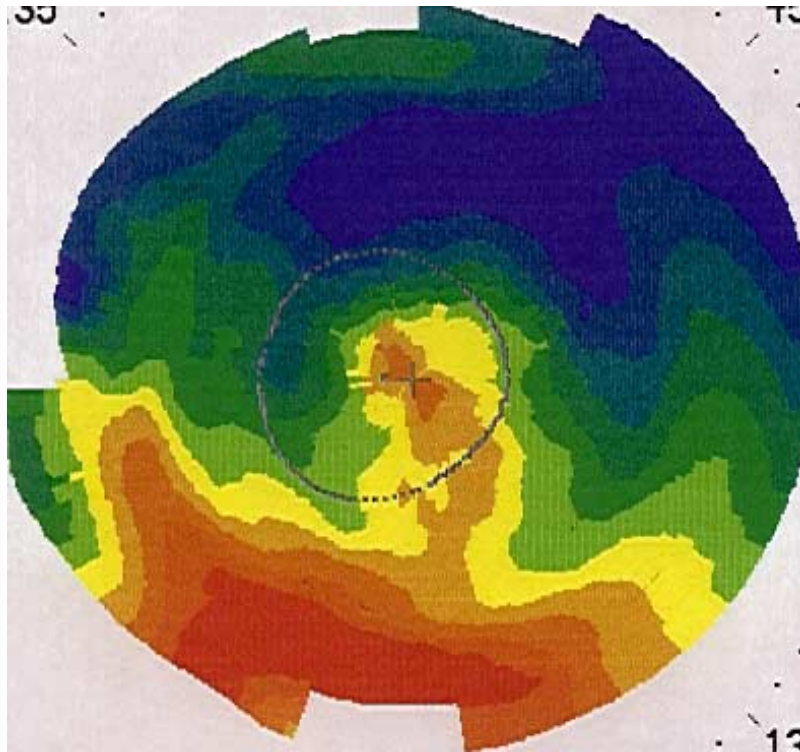
Figure 2. (Johnston) A. Left: One day after surgery mild red cells are noted in the inferior-nasal quadrant. Topography show a central island and peninsula in the affected area; B. Right: Nine months after surgery mild residual topographic changes persist.



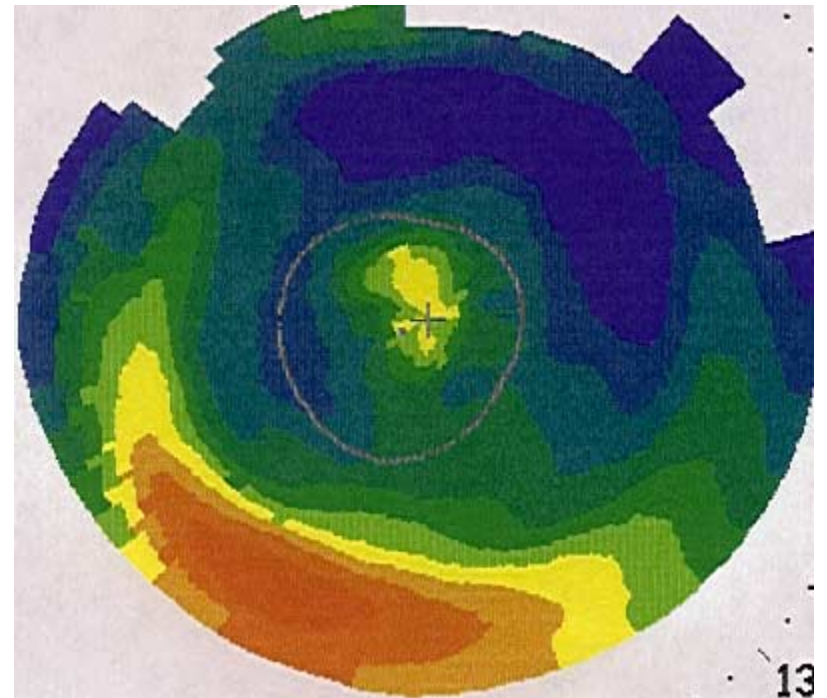
## Case 3- Day 1

- 4+ lipid droplets in the interface
- Pre-Existing acne and rosacea
- Inferior peninsula

**One day**



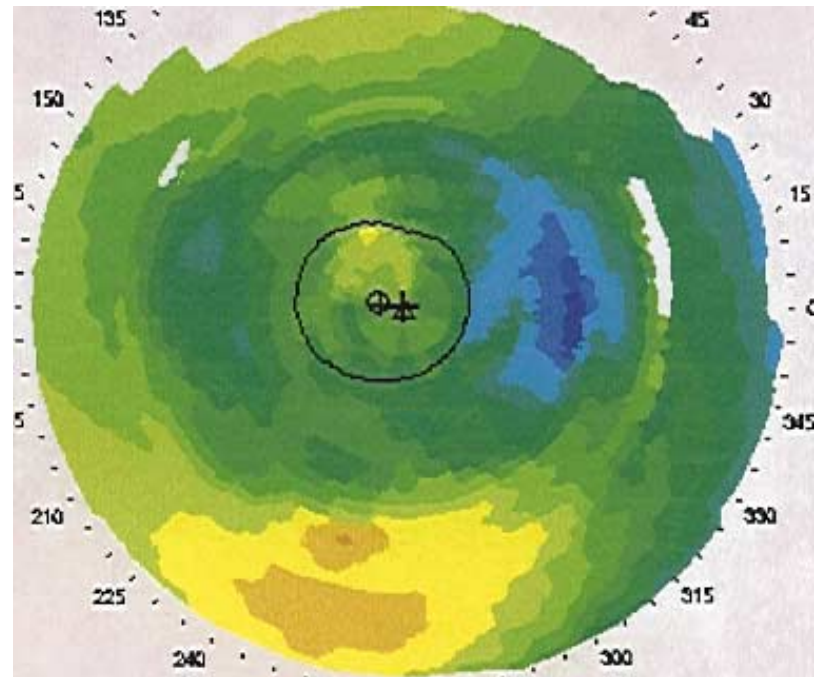
**Three days**



**Figure 1.** (Johnston) A. Left: One day after surgery diffuse lipid is noted under the flap. Topography shows a central island and an inferior peninsula; B. Right: Three days after surgery less lipid is noted under the flap and topography shows significant resolution

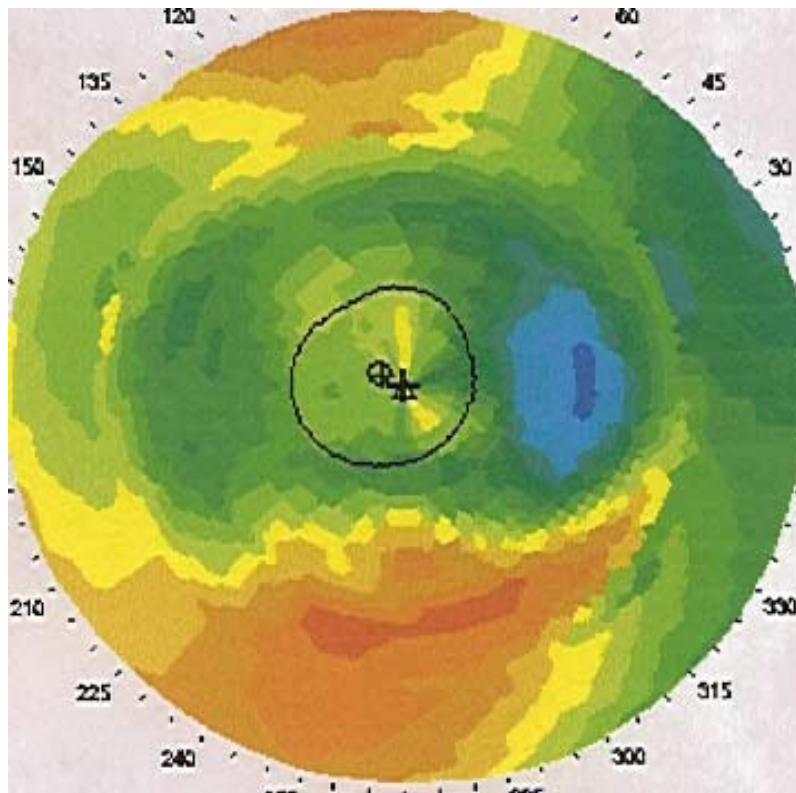
# Case 4- Day 1 AM

- Vision 20/20
- **Fine granular material** in the inferior **LASIK** interface
  - Material consistent with desquamated corneal epithelial cells



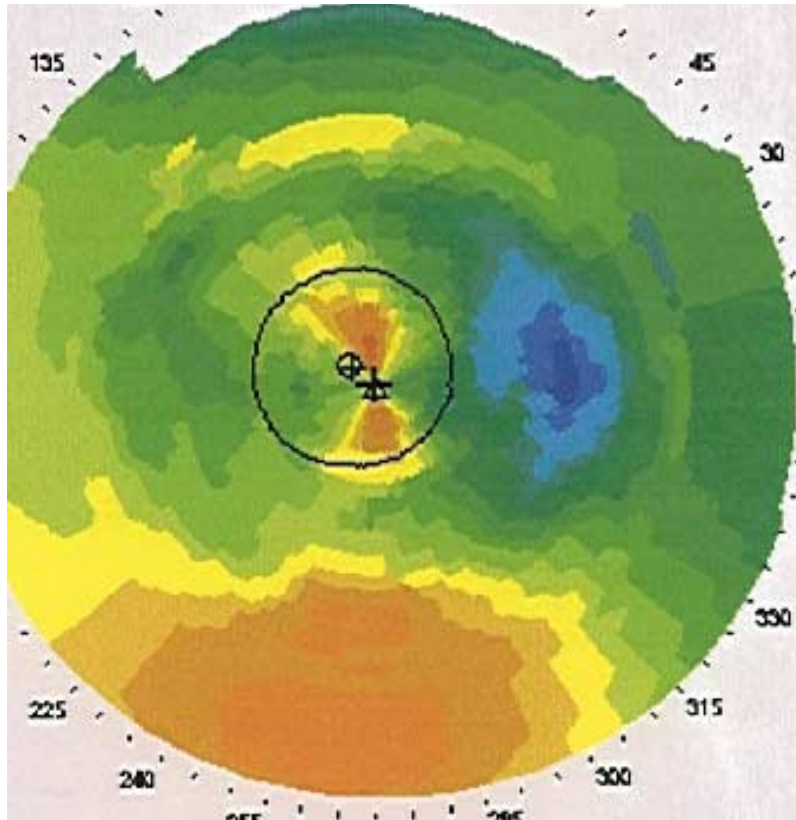


## Case 4- Day 1 PM



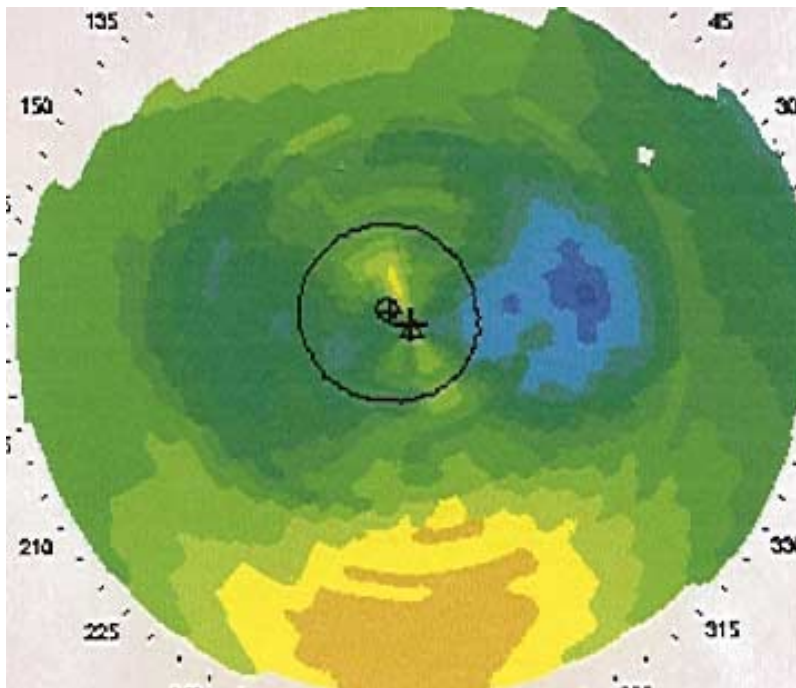
- Vision 20/30
- **Migration** of the interface **debris** into the inferior mid-peripheral interface
- **Topography** showed increased corneal thickness in the area of the shifting debris

## Case 4 -day 2



- Further shift in the debris
- **New central island was noted**

## Case 4- day 4



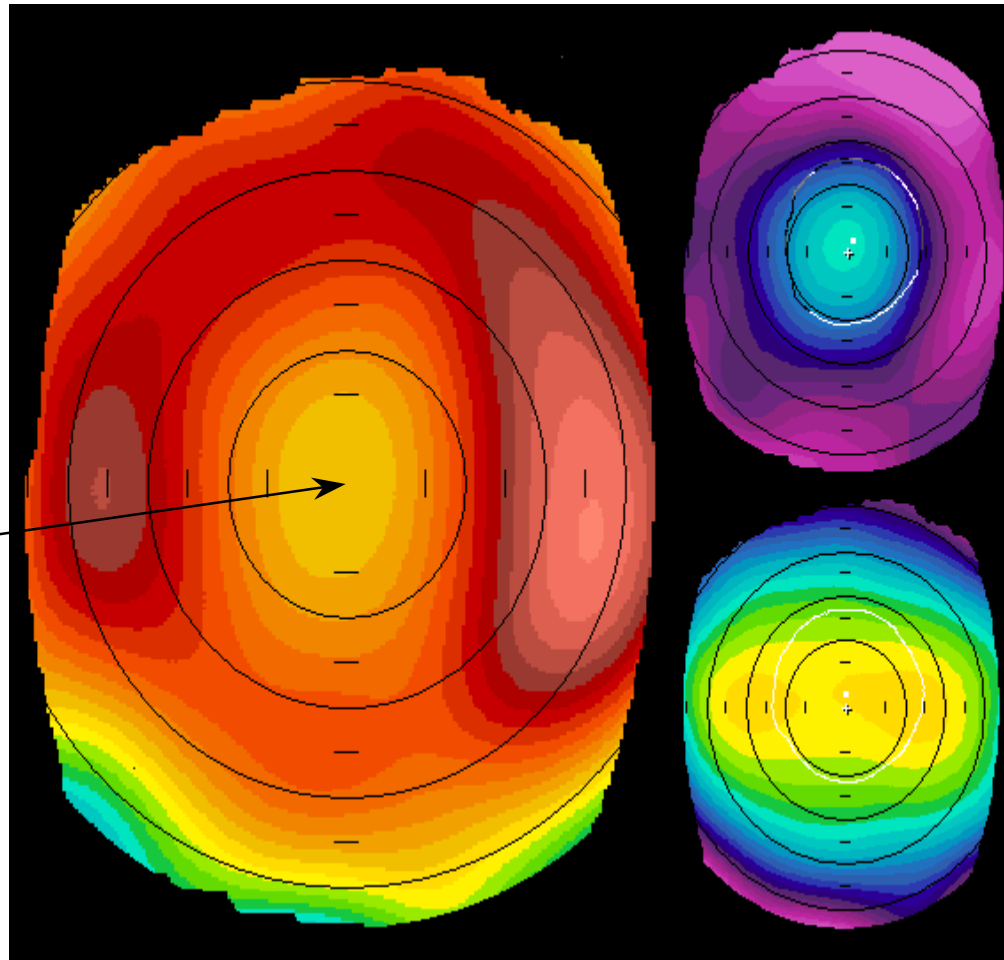
- The island is resolved
- Further migration noted
- Vision has improved to 20/25



# "Ablation" Immediately Post-Op

Post - Pre  
pachymetry  
difference

40  
micron  
central  
thicknes  
increase!



0.9 hour  
post-op  
pachymetry

0.0 hour  
pre-op  
pachymetry

10 microns per contour step

25 October 1997

Edema following LASIK

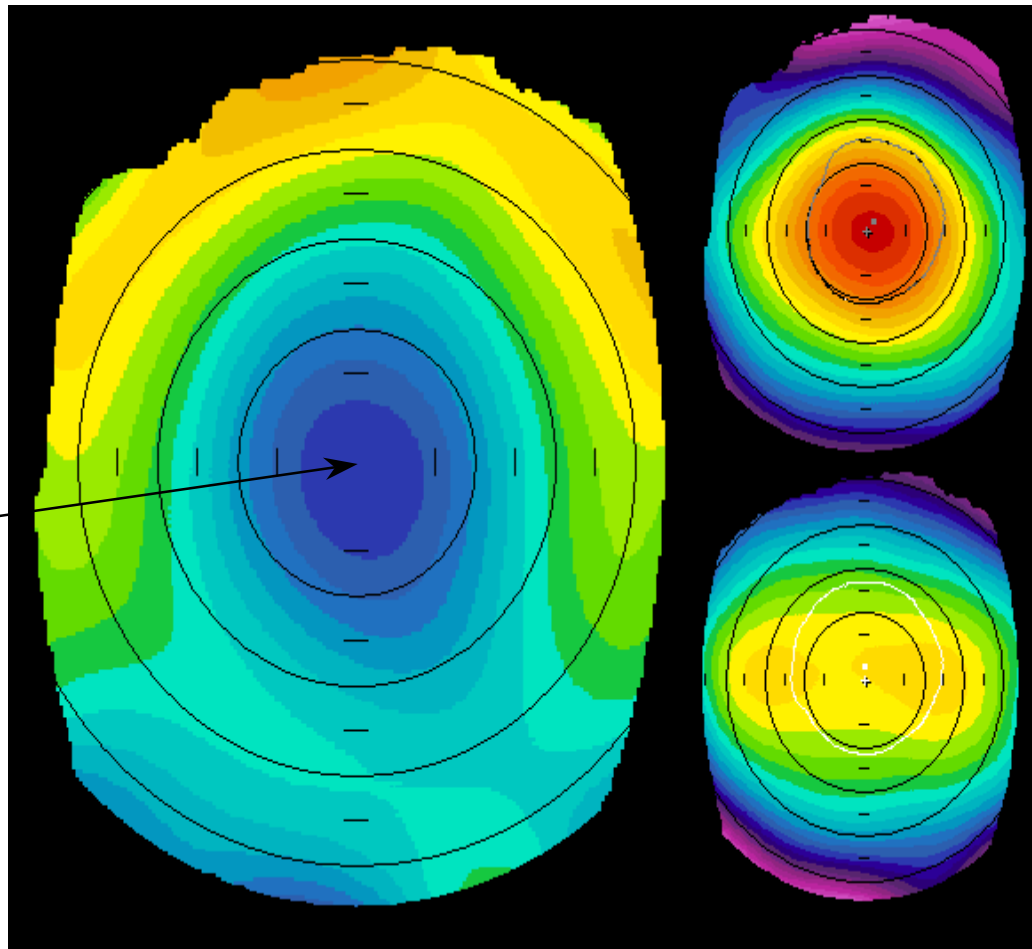




# Ablation 20 Hours Post-Op

Post - Pre  
pachymetry  
difference

3 micron  
central  
ablation



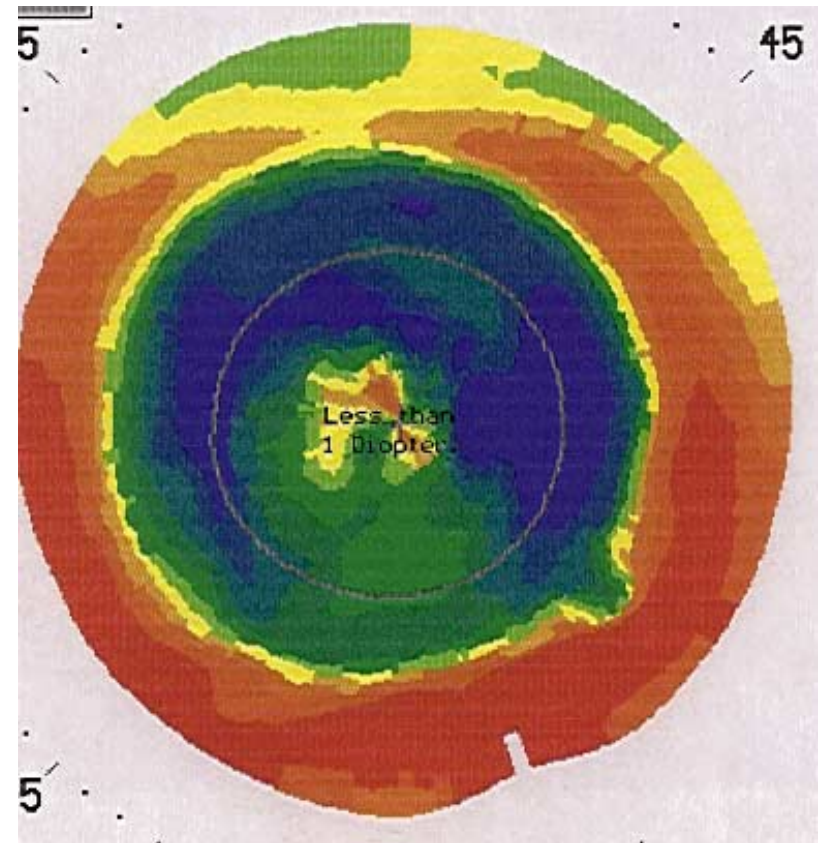
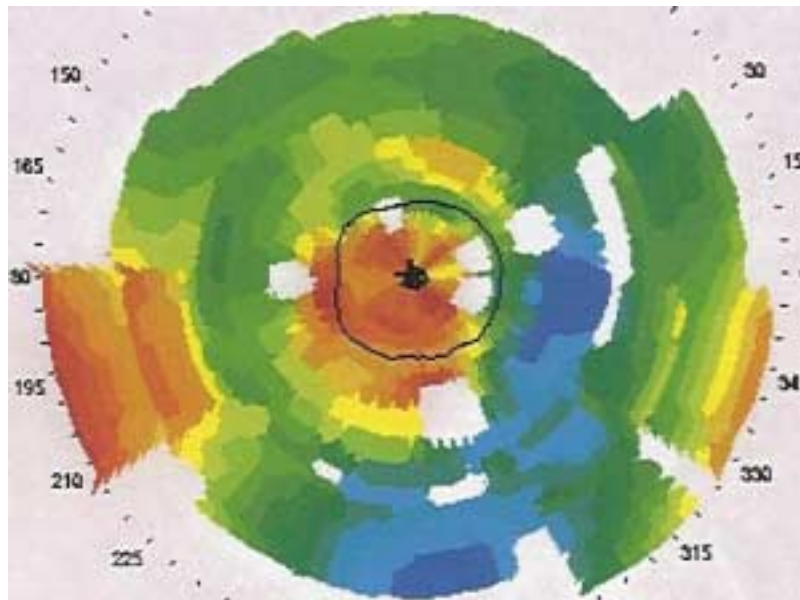
20.3 hours  
post-op  
pachymetry

0.0 hour  
pre-op  
pachymetry

10 microns per contour step

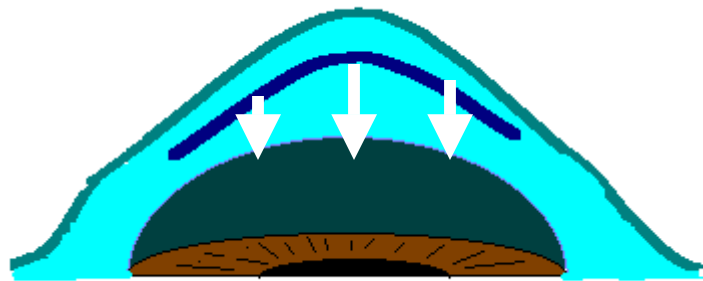
25 October 1997

Edema following LASIK



**Case 5.** ( Johnston) A. Left: Thirty minutes after surgery a central island and moderate flap and deep stromal edema are noted. B. Right: Six weeks after surgery a central island persists.

# Microstria formation



- Swelling of the stroma increases the arc length of the stromal base and posterior flap
- With resolution of the swelling there is infolding of the flap



## Conclusion

- Fluid and debris are actively aspirated into the LASIK interface and corneal stroma until the epithelial barrier is intact
- Late migration in the interface after the epithelium is intact



## Conclusion

- Stromal Suction may be related to
  - Interface changes
  - Islands and Peninsulas
  - Micro-folds
  - Under-corrections