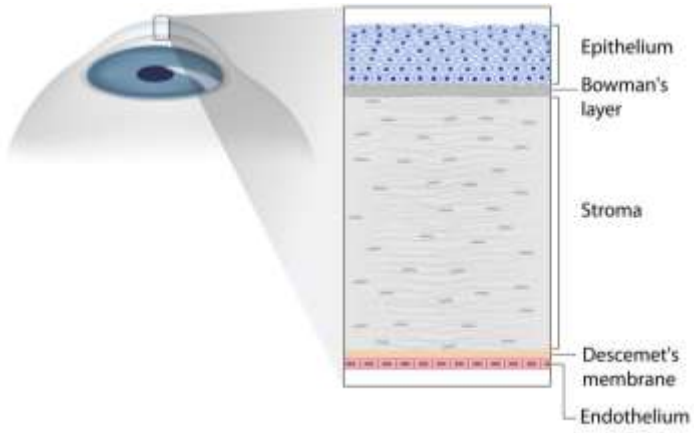
EPITHELIAL MAPPING:
A New Tool in Clinical Practice

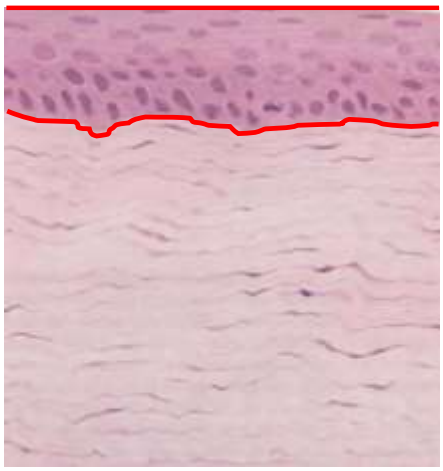
Samar Sherif
Al Watany Eye Hospital

Background

Background



Corneal Epithelium



- Features rapid cell-turnover
- Highly reactive to irregularities in the underlying stroma
- Always attempting to smoothen the ocular surface

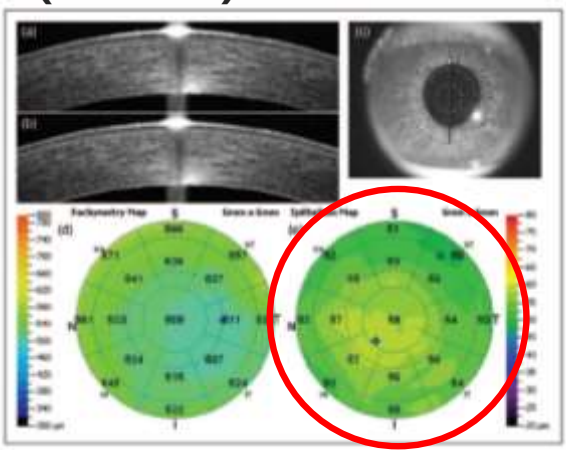
Analysis of Corneal Epithelium

- Optical Pachymetry
- Very High Frequency Digital Ultrasound
- Confocal Microscopy
- Anterior Segment OCT (AS-OCT)

Anterior Segment Optical Coherence Tomography (AS-OCT)

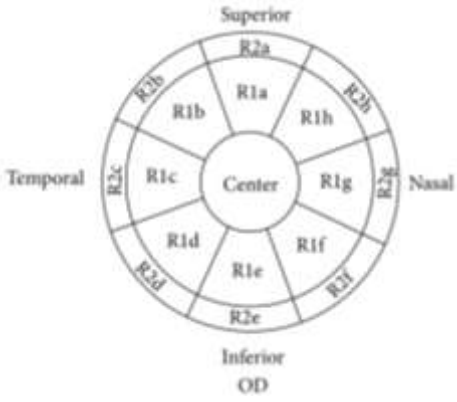
- Do not require eye contact and no immersion: the tear film is not disturbed and incorporated
- Types:
  - Time domain (TD-OCT): 2048 A-scans per second.
  - Fourier domain (FD-OCT): axial resolution of 5mm and a transverse resolution of 15mm, and up to 26 000 A-scans per second. Augmented mapping area from 6 to 9-mm zone.

Anterior segment optical coherence tomography (AS-OCT)



- Vertical Optical Section
- Corneal Epithelium Edge Detection line
- Total Pachymetric Map
- Epithelial Thickness Map

UNDERSTANDING EPITHELIAL MAPPING



- 3 main parts and 17 sectors
- Center, Ring1, Ring2
- Ring1: R1a to R1h
- Ring2: R2a to R2h

Reinstein Rules Of Epithelial Modulation

REINSTEIN RULES OF EPITHELAL MODULATION

Normal Epithelium and Changes

1. Average central epithelium thickness has been demonstrated to be around 54 µm, with a SD of 4–5 µm, with non unified pattern being thick in the inferior and nasal areas.
2. Corneal epithelium thickens to fill depressions
3. Corneal epithelium thins over peaks or protrusions
4. Rule of proportional change: The corneal epithelium changes proportional to the stromal changes
5. Rule of the amount of change: The magnitude of epithelial change is defined by the rate of curvature change of the stromal surface
6. Epithelial limit for compensation for irregularities.

J Refract Surg. 2009 May ;**25**(5):444–450

Application In Refractive Surgery Assessment

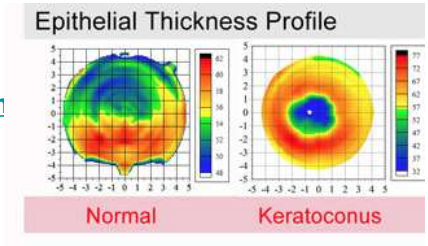
Preoperative Mapping Benefits

- Epithelial thickness mapping provides **additional supporting evidence** in the diagnosis, which allows us to offer alternative treatment options.
- *Kanellopoulos et al* found that overall epithelial thickness appears **increased in ectatic corneas.**

Case Rep Ophthalmol. 2013;**4**:74-78

Screening for Subclinical Keratoconus

- The epithelium gets thinner at the cone but thickens around the cone.
- Epithelial mapping will show a **doughnut pattern**
- Epithelial mapping can therefore be useful in screening laser refractive surgery patients for subclinical keratoconus.



J Cataract Refract Surg. 2017;43:60–66

Refractive Regression

- Corneal epithelial changes are known to play a role in refractive regression.
- Therefore, it is helpful to differentiate between regression due to **epithelial hypertrophy** and **early corneal ectasia**, where it thins over areas of relative increases in corneal curvature and thickens over areas of relative flattening in corneal curvature.
- In the case of regression, **enhancement is possible** provided that adequate tissue is available.
- If the patient is an ectasia suspect, one would either only do **crosslinking** of the cornea or perform **topography-guided PRK** with a crosslinking procedure.

Application in LASIK

- Myopic ablation, the corneal epithelium **thickens in the center** of the cornea and then progressively became **thinner towards the periphery**.
- Hyperopic ablation, there is epithelial **thinning over the zone** in which the stroma is steepened with **paracentral epithelial thickening**.
- Most of these epithelial changes occur within the first 24 h after surgery, and that there are no significant changes after 3 months.

J Refract Surg 2012; 28:195–201

Application in Surface Refractive Surgery

- **Masking effect** inherent to the epithelium
- Compensatory epithelial mechanism can negatively affect the results of wave front or topography-guided ablations

Reinstein DZ, Archer TJ, Gobbe M. Improved effectiveness of transepithelial PTK versus topography-guided ablation for stromal irregularities masked by epithelial compensation. J Refract Surg (Thorofare, NJ: 1995) 2013; 29:526–533.

Application in Dry Eye

- Objective, noninvasive, and reliable tear meniscus parameters for the diagnosis of dry eye.
- Precisely measure tear meniscus height and area
- Examiner-independent mode
- Dry eye patients have thinner corneal thickness and epithelial thickness than control.

Raj A, Dhasmana R, Nagpal RC. Anterior segment optical coherence tomography for tear meniscus evaluation and its correlation with other tear variables in healthy individuals. J Clin Diagn Res 2016; 10:; Nc01-04.

Take Home Message

Take Home Message

A good knowledge of the corneal epithelium distribution may help a lot in many aspects of clinical work, such as screening for keratoconus before corneal refractive surgery, fitting contact lens, and increasing the accuracy of corneal refractive surgery.

THANK YOU