Commentary: Usefulness of corneal epithelial thickness measurement

Corneal epithelium is the anteriormost layer of the cornea, which contributes to refractive power of the eye, minimizes stromal irregularity, as well as provides a smooth corneal surface. Measurement of corneal epithelial thickness may provide answers to some unresolved mysteries as to what causes regression after uneventful refractive surgery. A concrete diagnostic tool to diagnose subclinical keratoconus also may help in better and predictable outcomes after phototherapeutic keratectomy (PTK) for corneal irregularities. A complete knowledge of the normal epithelial thickness is the key in understanding the pathologies related to changes in corneal epithelium.

Various imaging modalities can be used to measure the epithelial thickness, although none of them have been considered as the gold standard. These include the confocal microscopy, high-frequency ultrasound optical coherence tomography (OCT), and Scheimpflug imaging.[1] Average corneal epithelium of normal eyes as measured by OCT (spectral domain) is 53.4 ± 3.2 μm in most of the studies, while it is 54.1 ± 2.96 μm as measured by very high-frequency ultrasound (VHFU).[2] Anterior Segment Optical Coherence Tomography (AS-OCT) gives a high-resolution two-dimensional image of a three-dimensional structure. Since it is a non-contact method, it is comfortable for the patient and also avoids the risk of corneal abrasion and infection. An important point to remember is that it is unable to differentiate the tear film from the epithelium, so this must be taken into account when evaluating OCT images, whereas VHFU disrupts the tear film with the coupling fluid, and therefore does not incorporate the tear film thickness. The earliest AS-OCT was described in 1994, which was based on time domain and had a very low resolution of 30 μm and could not delineate the epithelium. Then came the spectral domain OCT (SD-OCT) with a better resolution, but it could image only 6 mm diameter of the cornea. The latest SD-OCT machine scans at an axial resolution of 5 μm and covers 9 mm diameter.[3] Reproducibility of this technology has been confirmed by another study.[4] A study carried out by Hashmani *et al*.[5] on 220 normal eyes found that the center of the corneal epithelium is thicker than the periphery in all zones, except the nasal zone. The superior quadrant was found to be thinnest, while the inferior quadrant was found to be thickest. Similar observation was published in an Indian study of 263 patients.[6] In another study of 67 normal eyes, the epithelial thickness was non-uniform and independent of the underlying corneal thickness.[7] It was thinner in the superior and superotemporal sectors of the 2–5 mm zone (4.95 ± 9.96 and 4.1 ± 6.88 μm thinner than the radially opposite inferior and inferonasal sectors, respectively). The reason for such an asymmetrical pattern of epithelial thickness has been explained by many theories. One is that blinking abrades the superior corneal epithelium, causing desquamation and thinning of the superior cornea. The upper eyelid also applies a greater force on the cornea due to gravity. Lastly, a theory proposed by King-Smith *et al*.[8] suggests that pooling of the tear film in the inferior meridian causes a falsely more reading inferiorly.

Thus, the measurement of corneal epithelial thickness due to development of imaging technologies has paved a way to understand the epithelial response to various corneal insults. The essential role of the epithelium is to minimize stromal irregularity. This manifests in the form of epithelial thinning in focally steep regions of the cornea and thickening in regions with stromal tissue loss. The change in epithelial thickness is essentially independent of underlying stromal thickness changes, but is dependent on the change of the surface curvature.[9] This is seen in patients with high myopia undergoing refractive surgery. With more extensive central tissue ablation, there is significantly more thickening of the epithelium postoperatively.

The most important role of measuring epithelial thickness lies in the diagnosis of subclinical keratoconus. Rocha *et al*.,[10] in their study, reported the apical thickness of keratoconic patients to be significantly thinner at 41.18 ± 6.47 µm, whereas Li *et al*.[11] reported it as 51.9 ± 5.3 µm.[10,11] It has been established that the keratoconus patient had significantly higher epithelial thickness variability.[11] The morphology of the epithelium thinning over the cone and thickening around it in patients with keratoconus has been classically described as "doughnut" shaped.

Although not yet established as a diagnostic modality for keratoconus suspects, epithelial thickness with the pattern variables and Scheimpflug variables may have a role in future for the determination of keratoconus suspects. Like how visual fields are essential for following the progression of glaucoma patients, epithelial thickness profile and pattern change over a period of time may play a decisive role in the field of keratoconus diagnosis and management.

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Quick Response Code:

Website: www.ijo.in

DOI: 10.4103/ijo.IJO_3062_21

Cite this article as: Thakur A, Jain AK. Commentary: Usefulness of corneal epithelial thickness measurement. Indian J Ophthalmol 2022;70:1178-9.