Advanced Anterior Segment OCT Applications

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Summary

Advances in anterior segment optical coherence technology (OCT) are revolutionizing the way we assess the ocular surface and fit specialty lenses. This course will provide updates on this technology and how it is being utilized to better treat ocular surface conditions and fit specialty lenses.

Learning Objectives

1) Understand corneal thickness and management of anterior segment disease including keratoconus and Fuch's endothelial dystrophy
2) Discussion of epithelial thickness map and its role in anterior segment disease
3) Understand applications of anterior segment OCT measurements and how to utilize the measurements with specialty lenses

Course Outline

1) Anterior segment OCT
    a. Corneal measurements
        i. Measurements of the corneal thickness in different areas
        ii. Differs from standard ultra sound pachymetry
            1. Ultrasound is central cornea
            2. OCT provides additional information
        iii. Gives perspective on true shape of the cornea
        iv. Differs from topography
            1. Topography measures curvature
            2. OCT measures shape and thickness
        v. Can be monitored overtime for a number of ocular conditions
        vi. Can help modify treatments when changes are detected
    b. Epithelial thickness mapping (ETM)
        i. Measures the thickness of the epithelium in a 6mm diameter in the center of the cornea
        ii. Currently learning and understanding it's clinical applications
        iii. Expected thickness is between 49 to 60um
2) Pachymetry scans
    a. What is it?
        i. Provides thickness measurements of the cornea over a given area
    b. Keratoconus
        i. Shows Areas of thinning associated with areas of additional steepening

ii. Profile scans allow for better perspective on shape
iii. Can diagnose keratoconus with high level of reliability
1. Keratconus diagnosis with and optical coherence tomography-based pachymetric scoring system. Bing Qin, et al.
2. Looked at five key parameters
a. SN-IT
b. Minimum
c. Minimum-Median
d. Superior-Inferior
e. Ymin
3. Depending on measurements, is assigned a risk score
4. If total score is 0-3, has a low risk of keratoconus; greater than 3, has a high risk of keratoconus
iv. Can monitor corneal thickness overtime to determine if the keratconus is changing
c. Fuch's endothelial dystrophy
i. Decrease in endothelial cell density and the presence of guttata
ii. Global measurements of the corneal thickness can be monitored overtime to determine effects of treatment efforts

3) Epithelial thickness mapping (ETM)
a. What is it?
i. Measurement of the epithelial layer of the cornea
ii. Allows a given area to be measured
iii. New advancement in the eye care field
b. Dry eye
i. Mixed data on effects of on the epithelium
1. Certain studies show increased thickness
2. Others show thinning
3. Both may be right but may be measuring different stages of the disease
a. Thicker epithelial thickness may be initial swelling seen with increased inflammation
b. Thinning may be a sign of long term, chronic disease
4. What seems to be consistent in variability in thickness within the given area of the cornea
c. Keratoconus
i. Evident epithelial thinning at the steepest portions of the cornea
ii. Coincides with area on the cornea that is the thinnest
iii. Critical to monitor overtime
iv. Traditional gas permeable lenses
1. Will often times show areas of thinning where the lens may be bearing more

v. Scleral lens wearers, when appropriately fit, will not show altered areas of thinning because the lens doesn't put excessive pressure on cornea in any region

d. Fuch's endothelial dystrophy
    i. A condition of the endothelium
    ii. Can cause water in the stroma of the cornea through inadequate removal because of a poorly functioning endothelium

e. Corneal scarring
    i. Injuries
        1. Creates irregularities in the stroma and epithelial thickness
    ii. Refractive surgery
        1. Radial Keratotomy
        2. Laser assisted in situ keratomileusis

f. Orthokeratology
    i. Reverse geometry lenses are placed on myopic patients to alter refractive error
    ii. Alters corneal epithelium
    iii. Will cause thinning in the region of the cornea corresponding to the area that alters the refractive error

4) Specialty lenses
    a. Scleral lenses
        i. Technology re-purposed to allow for measurements of corneal clearance
        ii. Central corneal clearance
            1. Area beneath the central portion of the lens and the cornea
            2. Allows for measurement of the central corneal clearance
            3. For irregular corneas, the minimum corneal clearance is measured
                a. Non-ectatic corneas
                    i. More standardized metrics
                    ii. Will have similar clearance across cornea
                b. Irregular corneas
                    i. Significant differences in lens clearance across cornea
                    ii. Discuss strategies to help mitigate variation in clearance
            4. Estimating Scleral Lens Clearance and Comparing it to OCT Measured Clearance, Mile Brujic (presented at GSLS 2016)
            5. Vertical scans of corneal clearance
                a. Expect even clearance of scleral lens over cornea
                b. Can determine vertical centration based on scan
                    i. Increased clearance inferiorly represents inferiorly decentered lens
                    ii. Expect equal clearance vertically over cornea
        iii. Limbal clearance

1. Reverse curves have created predictable limbal clearance for most patients
2. Understand the important anatomical markers
    a. Identifying the corneal limbal region
3. Discussion of appropriate identification of the limbal region
4. Identify appropriate clearance
5. Understand how to manipulate curves to optimize clearance

iv. Scleral landing zone
1. Understand benefits and limitations of OCT
2. Discuss how to interpret landing zone
3. Understand the desired approach
    a. Always view the approach from under the lens and its interaction with the underlying conjunctiva and sclera
4. Understand the limitations with viewing the conjunctiva past the lens edge and the interpretation mishaps because of the image shift
5. Discuss appropriate measurement in four quadrants of the lens to determine characteristics in major meridians
    a. Critically important for toric landing zones
    b. Important to identify the steep and flat meridians and understand fitting characteristics in each meridian