Corneal Diagnostics A-Z

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Course Length: 1 Hour

Course Abstract:

Practitioners have all the toys to diagnose and monitor the posterior segment, but what about the cornea??? This lecture will teach how to use a variety of corneal diagnostics, with focus on technologies such as topography, tomography, specular and confocal microscopy, biomechanics, aesthesiometry, genetic testing and more. Come learn how to diagnose and monitor diseases affecting the most important part of the eye!*

*BIAS OPINION

Course Learning Objectives:

1. Learn methods of corneal evaluation with multiple instruments
2. Understand metrics used to diagnose and monitor keratoconus and ectasia
3. Learn how to apply these findings to relevant real-world situations with cases

Course Outline:

1. Why care?
    a. Clinical Decisions
        i. Corneal based treatment vs alternatives
            1. Myopia
                a. Early signs?
                    i. Avoid corneal based therapy
                        1. Ortho K alters anterior cornea, removes the ability to early dx with Placido topography
                            a. Alternative therapy
                                i. Atropine
                                ii. Soft MF
                                iii. Defocus spectacle lenses
                        2. Follow up more frequently
                            a. Pediatric population
                                i. KC signs in younger population = more likely have severe disease
            2. Refractive surgery

a. Corneal based refractive surgery = LASIK/PRK
    i. Early signs?
        1. Avoid corneal based surgery
            a. Possibility of iatrogenic disease
            b. Alternative surgical options
                i. Lens-based refractive surgery
                ii. Forgo elective surgery all together
        2. Follow up more frequently

ii. Keratoconus
    1. Prevalence studies
        a. Historical prevalence is 1:2000
            i. Rabinowitz 1998
            ii. Kennedy et al 1986
        b. Most recently
            i. Hashemi et. al in 2020 - Worldwide = 1:725
            ii. Godefrooij et. al in 2017 - Netherlands = 1:375
            iii. Papali'i-Curtin et. al in 2019 - New Zealand = 1:191
            iv. Chen et. al in 2020 - Australia = 1:84
        c. Increases in prevalence are related to improvements in diagnostic technology
    2. KC diagnosis is delayed
        a. Godefrooij et. al in 2017:
            i. Mean dx at 28.3 y/o
                1. Early signs missed
    3. US Military (Reynolds et. al 2020)
        a. 2001 to 2018
        b. KC is a disqualifier for military enrollment
            i. 18 and older
        c. Reviewed incidence of KC development in an otherwise healthy population
        d. 1:1700
    4. Chicago School System KC Screening
        a. Started in 2016
        b. Tomography
        c. 2% positive for KC

iii. Genetics studies
    1. Fransen E, et al 2021
        a. Candidate genes for KC & Ehlers-Danlos Syndrome genes
    2. Hardcastle AJ, et al 2021
        a. GWAS collagen matrix integrity and cell differentiation in KC
    3. Bykhovskaya Y, et al 2021

        a. Update on the genetics of KC
2. BOTTOM LINE:
    a. UNDERSTANDING AND IMPLEMENTING DIAGNOSTICS IS IMPORTANT
        i. THESE WILL AFFECT YOUR CLINICAL DECISIONS
        ii. THESE AFFECT MORE THAN JUST KC
        iii. KC IS MORE COMMON THAN YOU THINK
3. Simple diagnostic factors to alert for the need for testing
    a. Review of refraction study
        i. Chung et al 2020
            1. Average axis orientation: oblique or ATR
            2. Cyl (refractive or K) > 1.5D should be worked up
    b. Review of retinoscopy study
        i. Al-Mahrouqi et al 2019
            1. Compare retinoscopy to Pentacam BAD D-value findings ≥2.69.
                a. The results to assess the validity and reliability.
            2. Retinoscope is sensitive for detection even in early KC
4. Topography metrics
    a. Anterior only
        i. Rabinowitz et al
            1. K (Central and Apical) > 47D
            2. IS > 1.4D
            3. Skew (SRAX) > 20deg if >1.5D
                a. Examples
    b. Cases
        i. KC or surface?
            1. Mires matter
        ii. Is is KC?
    c. Clinical pearl:
        i. Symmetry is key!
        ii. Look out for tear film
            1. Corneal staining
            2. Treat and repeat
5. Tomography metrics
    a. Full corneal metrics
        i. Motlagh et al
            1. Curvature (Axial Map)
                a. Same metrics apply
            2. Elevation (Posterior >20>Anterior >15)
            3. Pachymetry (<500)
                a. Examples
        ii. Li et al
            1. Epithelial doughnut pattern
                a. Apical epithelial thinning and peripheral thickening
                b. Max to min thickness: ~20μm

i. Examples

b. Cases
   i. Elevations vs curves
   ii. The KC backside
   iii. Thickness gradient
c. Clinical pearl:
   i. Topo rules apply to anterior maps
   ii. Adds posterior surface and global pachymetry!
      1. Focal elevations
      2. Thickness gradients

6. Aberrometry metrics
   a. Full visual system
      i. Li et al and Kosaki et al
      ii. Higher-order aberrations
         1. Vertical COMA is the predominate aberration
            a. Followed by Trefoil
      iii. Normal vs Suspect vs KC
         1. <0.2 vs ~0.2-0.3 vs >0.3
            a. Examples
   b. Cases
      i. The cornea or internal?
   c. Clinical pearl:
      i. Sensitive but nonspecific!!
      ii. Coma and trefoil!
7. Confocal Microscopy
   a. Images of different structural cellular layers
      i. Comparable to histology of the living cornea
      ii. Detection and management of infectious corneal conditions
         1. Acanthamoeba keratitis
      iii. Nerve evaluation in naturopathic conditions
8. Specular Microscopy
   a. Evaluation of the corneal endothelium
      i. Polymegathism
      ii. Pleomorphism
      iii. Reduced cell density
   b. Monitor
      i. Contact lens related cellular changes
      ii. Grafts
      iii. Corneal dystrophies
9. Biomechanics metrics
   a. Roberts et al and Dupps et al
      i. Corneal resistance factor (CRF): Rebound
      ii. Corneal hysteresis (CH): Elasticity (less important)

1. Factors are not sensitive and specific enough to differentiate subclinical from normal
    a. Newer devices exist internationally
        i. Scheimpflug waveform
            1. Global weakness
    b. Several devices in development
        i. Brillouin
            1. Focal weakness
        ii. Elastography
            1. Depth weakness

b. Cases
    i. Normal shape but super weak
c. Clinical pearl:
    i. Poor diagnostic value on its own
    ii. Low corneal resistance
        1. Fast deformation

10. Genetic testing
    a. Cases
        i. High-risk score and progression
    b. Clinical pearl
        i. Assess risk before physical manifestation
11. Combine testing
    a. Cases
        i. Need it all to figure it out
    b. Clinical pearl:
        i. Combine for most accurate
        ii. Think like glaucoma
            1. More findings = more risk
                a. Follow up sooner
12. Monitoring
    a. Worsening of the aforementioned metrics = progression
        i. Refer for treatment with CXL
    b. Suspicious or borderline findings?
        i. Think like glaucoma!!
            1. Complete corneal work up
            2. Avoid corneal based treatments
            3. Follow up frequently
                a. Pediatric population: every 3 months
                    i. Progression = immediate treatment with CXL