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INDIANA UNIVERSITY
Bloomington

BLOW DRY MY EYES?

MANAGEMENT AND REVIEW OF CORNEAL DYSTROPHIES

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Course Description

The course will provide a brief review of common management tools for corneal dystrophies, while also providing an introduction and overview of recent additions to the management toolbox.

Additionally, genetic, anatomical, histological, and clinical factors of common anterior, stromal, and posterior corneal dystrophies will be discussed, and current management options for each dystrophy will be reviewed.

Course Objectives

- To provide a working "definition" of corneal dystrophies
- To review corneal anatomy
- To provide a broad classification of corneal dystrophies based on corneal anatomy
- To review issues of inheritance and onset of corneal dystrophies
- To review examination strategies used in diagnosing corneal dystrophies

Goals/Objectives

- To provide a review of common management options for corneal dystrophies
- To provide a more in-depth review/introduction to new options for the management of corneal dystrophies

Goals/Objectives

- To provide a review of common anterior, stromal and posterior corneal dystrophies, looking at the following factors
  - Naming
  - Genetic
  - Anatomical
  - Histological
  - Clinical
  - Management

Disclosures

None

Thanks to Drs. Brad Sutton and Lorie Logan for photos

Background

"Definition"
Corneal Anatomy
Classification
Inheritance and Onset
Examination
Management Options

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Dystrophy "Defined"

- Imprecise term - clinical value
- Genetically determined
  - Restricted to the cornea
  - Heterogeneous
  - Bilateral
  - Spontaneous
  - Variety of phenotypes
- No systemic manifestations
- Visual acuity - variable
- Clinically diagnosed - enhanced with microscopic and genetic analyses

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IC3D Categorization

The categories are as follows:

- **Category 1:** Well defined; gene has been mapped and identified and specific mutations are known
- **Category 2:** Well-defined; gene (or genes) remains to be identified
- **Category 3:** Well-defined; not yet been mapped to a chromosomal locus
- **Category 4:** Suspected new (or previously documented) corneal dystrophies; evidence not yet convincing

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Corneal Anatomy

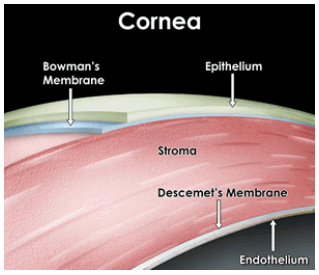

Diagram from http://www.lasik.md/learnaboutlasik/prk.php

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Corneal Anatomy

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Classification

- Anterior or superficial corneal dystrophies
  - Corneal epithelium and its basement membrane
  - Bowman layer
  - Superficial corneal stroma
- Stromal corneal dystrophies
  - Corneal stroma
- Posterior corneal dystrophies
  - Descemet's membrane
  - Corneal endothelium

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Inheritance and Onset

- Mendelian inheritance (autosomal dominant, autosomal recessive or X-linked recessive)
  - Phenotypic diversity/variable penetrance
- Variable age of onset
- A few corneal dystrophies are congenital
  - Developmental anomalies

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Examination

- Slit lamp examination
  - Parallelepiped
  - Optic section
  - Indirect illumination
  - Retro-illumination
- Biopsy/microscopic examination
- Genetic testing

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Management Options

- Palliative
  - Non-preserved artificial tears (NPATs)
  - Bandage soft contact lens (BSCL)
- Sodium chloride solution and ointment (NaCl)
- Blow dry
- Stromal puncture

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Management Options

- Epithelial debridement
  - Spatula
  - Alcohol
  - Diamond burr polishing

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Management Options

- Epithelial debridement
  - Phototherapeutic keratectomy (PTK)

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Management Options

- Penetrating keratoplasty (PKP)
- Lamellar keratoplasty (LKP)

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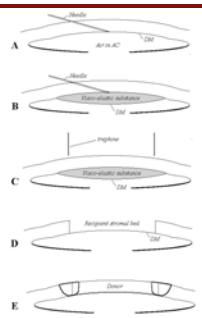
Anterior Lamellar Keratoplasty



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Management Options

- Endothelial keratoplasty
  - Descemet stripping endothelial keratoplasty (DSEK)
  - Donor tissue
    - Posterior stroma
    - Descemet's
    - Endothelum

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Management Options

- Endothelial keratoplasty
  - Descemet membrane endothelial keratoplasty (DMEK)
  - Donor tissue
    - Descemet's
    - Endothelum

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Anterior Corneal Dystrophies

Epithelial Basement Membrane Dystrophy (EBMD)
Meesmann dystrophy (MECD)
Reis-Bücklers corneal dystrophy (RBCD)

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Epithelial Basement Membrane Dystrophy

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Epithelial Basement Membrane Dystrophy

- Also known as:
  - EBMD
  - Anterior Basement Membrane Dystrophy (ABMD)
  - Map-Dot-Fingerprint Dystrophy
  - Cogan's Dystrophy
  - Phenotype MIM (Mendelian Inheritance in Man) # 121820
  - Gene/Locus MIM # 601692
  - Peabody-Perotti Corneal Dystrophy (PPCD #1)

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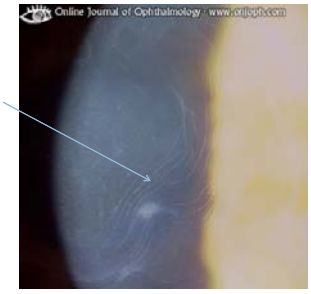
Epithelial Basement Membrane Dystrophy

- IC3D Category: Few forms are category 1
- Genetically
  - Few forms: TGFBI and are AD
  - Majority of cases are not a distinct inherited disorder
  - A nonspecific reaction to corneal insult?
- Anatomically
  - Epithelial basement membrane
- Histologically
  - Multi-laminar basement membrane
  - Intra-epithelial microcysts
  - Incomplete basement membrane complexes - no anchoring fibrils and few hemidesmosomes

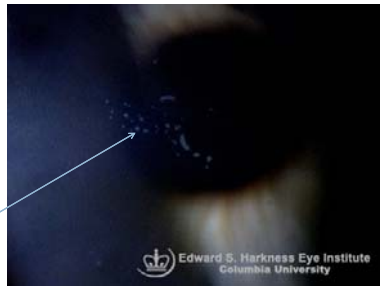
Epithelial Basement Membrane Dystrophy

- Clinically
  - Irritation
  - Map/dot/fingerprints in anterior epithelium
  - REE (10%)
    - Pain upon awakening (or, awakening upon pain)

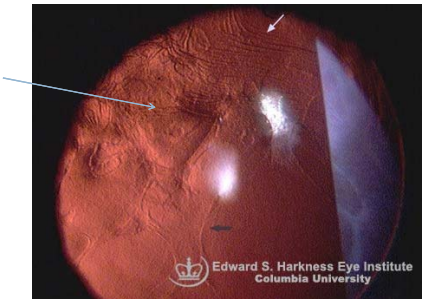
Epithelial Basement Membrane Dystrophy



Epithelial Basement Membrane Dystrophy



Epithelial Basement Membrane Dystrophy



Epithelial Basement Membrane Dystrophy

- Management
  - NPATs
  - BSCL
    - CPT = 92071
  - NaCl
  - Moisture chamber goggles
    - www.dryeyepain.com/Goggles.htm
  - Epithelial debridement
  - Anterior Stromal Micropuncture
- ICD-9 = 371.52 (Other anterior corneal dystrophies)

www.sarawakeyecare.com/Atlasofophthalmology/neuroophthalmology/Neuroophthalmologypicture21facialnerveplasy.htm

Meesmann Dystrophy

- Also known as:
  - MECD
  - Stocker-Holt dystrophy
  - MIM #122100
  - Peabody-Perotti Corneal Dystrophy #2 (PPCD #2)

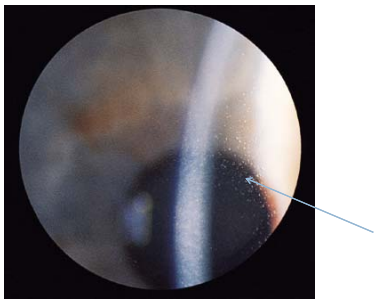
Meesmann Dystrophy

- IC3D Category: 1
- Genetically
  - AD
  - Genes
    - KRT3
    - KRT12
- Anatomically
  - Different levels of corneal epithelium
- Histologically
  - Intra-epithelial cysts of "peculiar substance"

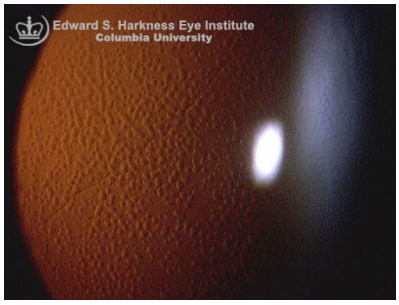
Meesmann Dystrophy

- Clinically
  - Onset – first decade of life (as early as year one)
  - Multiple distinct round or oval epithelial cysts that rarely come to the surface, mostly central, but more evenly distributed with middle age
  - Third-fourth decade
    - Cysts may come to surface
    - Mild ocular irritation, blurred vision, photophobia, irregular astigmatism, and mild scarring of central cornea

Meesmann Dystrophy



Meesmann Dystrophy



Meesmann Dystrophy

- Management
  - NPATs
  - BSCL
  - NaCl
  - Epithelial debridement – recurs!
  - Stromal puncture
- ICD-9 = 371.51(Juvenile epithelial corneal dystrophy)

Reis-Bücklers Corneal Dystrophy

- Also known as:
  - RBCD
  - Corneal dystrophy of Bowman layer type I
  - Geographic corneal dystrophy, superficial
  - Granular corneal dystrophy (GCD), atypical GCD, GCD type III
  - Anterior crocodile shagreen
  - Anterior limiting membrane dystrophy type I
  - MIM #608470

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Reis-Bücklers Corneal Dystrophy

- IC3D Category: 1
- Genetically
  - AD
  - Gene
    - TGFBI
- Anatomically
  - Central corneal epithelium
  - Bowman's layer
  - Anterior stroma
- Histologically
  - Extracellular mutant transforming growth factor beta induced protein deposits

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Reis-Bücklers Corneal Dystrophy

- Clinically
  - Onset – first decade of life
    - Age 4 or 5 typically
  - Curvilinear/geographic opacities at Bowman's layer and superficial stroma
  - Pain
  - Photophobia
  - Raised irregular corneal surface
  - REE
    - Scarring
    - Reduced visual acuities in third and fourth decade

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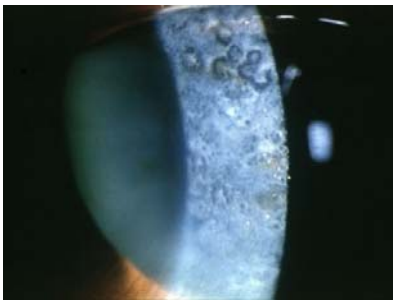
Reis-Bücklers Corneal Dystrophy



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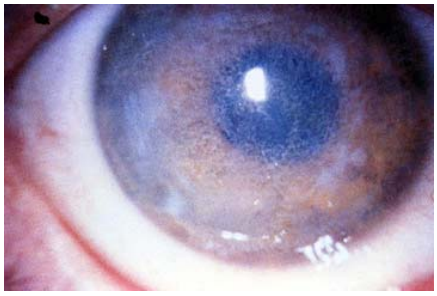
Reis-Bücklers Corneal Dystrophy



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Reis-Bücklers Corneal Dystrophy

- Management
  - NPATs
  - NaCl
  - Epithelial debridement
  - PTK
  - LKP – recurs
- ICD-9 = 371.52 (other anterior corneal dystrophy)

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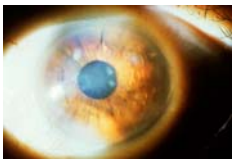
Less Common Anterior Dystrophies

- Subepithelial Mucinous Corneal Dystrophy
  - Very rare
  - Autosomal dominant
  - Frequent erosions in first decade followed by progressive vision loss
  - Typically central



Feder et al
Arch. Ophthalmol. 111 (8): 1106–14. PMID 8352693.

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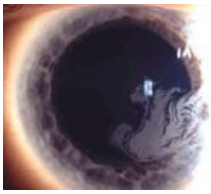
Less Common Anterior Dystrophies

- Lisch Epithelial Corneal Dystrophy
  - First described in 1992
  - X-linked (unusual)
  - Gelatinous, whorl-like associated with surface deposition
  - Appears as epithelial microcysts in retro
  - Initially spares central cornea
  - Not associated with recurrent erosions



www.reviewofcontactlenses.com/content/d/disease/c/21310/

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Stromal Corneal Dystrophies

Granular corneal dystrophy (GCD) type I
Lattice corneal dystrophies (LCD)
Macular corneal dystrophy (MCD)

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Granular Corneal Dystrophy Type I

- Also known as:
  - GCD I
  - Classic GCD
  - Corneal dystrophy Groenouw type I
  - MIM #121900
  - Avellino

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Granular Corneal Dystrophy Type I

- IC3D Category: 1
- Genetically
  - AD
  - Gene
    - TGFBI
- Anatomically
  - Central anterior stroma
- Histologically
  - Extracellular mutant transforming growth factor beta induced protein deposits

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Granular Corneal Dystrophy Type I

- Clinically
  - Onset – first decade
  - Discrete snowflake/breadcrumb opacities with intervening clear stroma; opacities may be linear and progressive
  - Glare
  - Decreased visual acuities possible
  - REE - rare

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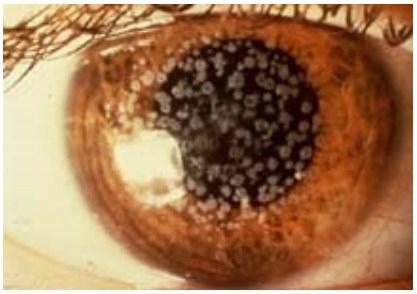
Granular Corneal Dystrophy Type I



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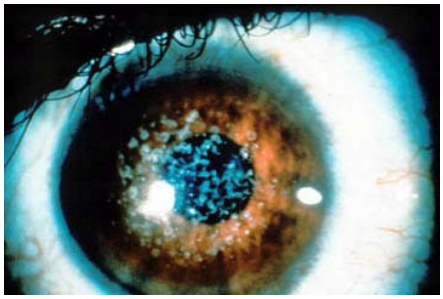
Granular Corneal Dystrophy Type I



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Granular Corneal Dystrophy Type I

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Granular Corneal Dystrophy Type I

- Management
  - PTK
  - LKP
  - PKP
  - Recurs
    - Usually clear for 30 months
    - May recur in first year
- ICD-9 = 371.53 (Granular Corneal Dystrophy)

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Lattice Corneal Dystrophies

- Also known as:
  - LCD 1 - No systemic associations
    - Biber-Haab-Dimmer dystrophy
    - MIM #122000
  - LCD 2 - Systemic associations (not "true" dystrophy)
    - Familial amyloid polyneuropathy type IV
    - Finnish or Meretoja type
    - FAP type IV
    - Meretoja syndrome
    - MIM #105120

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Lattice Corneal Dystrophies

- IC3D Category: 1(type 1 only)
- Genetically
  - AD
  - Gene
    - TGFBI (Type I and variants)
    - GSN (Type II)
- Anatomically
  - Stromal
- Histologically
  - Amyloid deposits

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Lattice Corneal Dystrophies

- Clinically - LCD1 (no systemic associations)
  - Onset – first decade
  - Linear, inter-digitating opacities in central cornea
  - Uncomfortable
  - Decreased corneal sensation
  - Slowly progressive
  - REE

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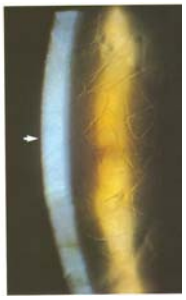
Lattice Corneal Dystrophies



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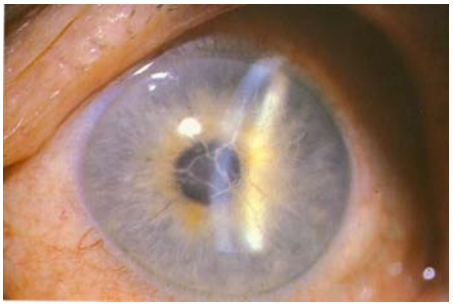
Lattice Corneal Dystrophies



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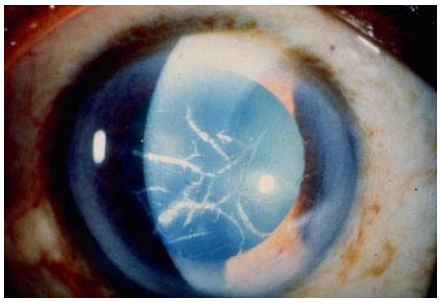
Lattice Corneal Dystrophies



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Lattice Corneal Dystrophies

- Management - LCD 1
  - NPATs
  - PTK
  - LKP
  - PKP may be required by third decade, but usually not until at least fifth decade
  - May recur 2-14 years after PKP
- ICD-9 = 371.54 (Lattice Corneal Dystrophy)

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Lattice Corneal Dystrophies

- Clinically - LCD 2 (systemic associations)
  - Onset – second decade
  - Radially oriented, short, fine glassy lines
  - Decreased visual acuities usually not before age 65
  - Systemically - bilateral cranial and peripheral neuropathy
    - Decreased corneal sensation
    - "Mask" like face – facial palsy
  - Dry, lax, itchy skin

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Lattice Corneal Dystrophies

- Management - LCD 2
  - PKP rarely required
  - Neurotrophic REE associated with PKP

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Macular Corneal Dystrophy

- Also known as:
  - MCD
  - Corneal dystrophy Groenouw type II
  - Fehr corneal dystrophy
  - MIM #217800

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Macular Corneal Dystrophy

- IC3D Category: 1
- Genetically
  - AR
  - Gene
    - CHST6
- Anatomically
  - All layers of stroma affected
  - May also affect Descemet's membrane and endothelium
- Histologically
  - Intra-cytoplasmic accumulations within keratocytes and corneal endothelium

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Macular Corneal Dystrophy

- Clinically
  - Rare
  - Onset – first decade
  - Indistinct gray-white opacities with intervening haze
  - Severe visual impairment by common by fifth decade as opacities coalesce

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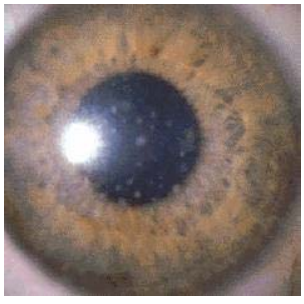
Macular Corneal Dystrophy



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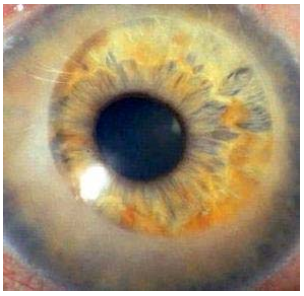
Macular Corneal Dystrophy



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Macular Corneal Dystrophy

- Management
  - PKP
  - May recur years after PKP
- ICD-9 = 371.55 (Macular Corneal Dystrophy)

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Posterior Corneal Dystrophies

Fuchs' endothelial corneal dystrophy (FECD)
Posterior polymorphous corneal dystrophy (PPCD)
Congenital hereditary endothelial corneal dystrophy (CHED)

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Fuchs' Endothelial Corneal Dystrophy

- Also known as:
  - FECD
  - Fuchs endothelial corneal dystrophy
  - Endo-epithelial corneal dystrophy
  - Late hereditary endothelial dystrophy
  - MIM #136800

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Fuchs' Endothelial Corneal Dystrophy

- IC3D Category: 1 or 2 (depending on onset)
- Genetically
  - AD
  - Genes
    - SLC4A11
    - TCF8
- Anatomically
  - Endothelium
- Histologically
  - Decreased endothelial cell count

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Fuchs' Endothelial Corneal Dystrophy

- Clinically
  - Onset – usually fifth to sixth decade
  - Corneal guttata (excrescences!)
    - May be surrounded by pigment
    - Orange peel/beaten metal
    - Best seen in retro
  - Corneal endothelial decompensation/edema

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Fuchs' Endothelial Corneal Dystrophy

- Clinically
  - Initial stages, blurry vision in AM that improves
  - Later, epithelium takes on water
    - Leads to bullous keratopathy
  - Decreased VA's due to:
    - Surface changes
    - Subepithelial fibrotic scarring
  - Pain due to bullae rupture

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Fuchs' Endothelial Corneal Dystrophy

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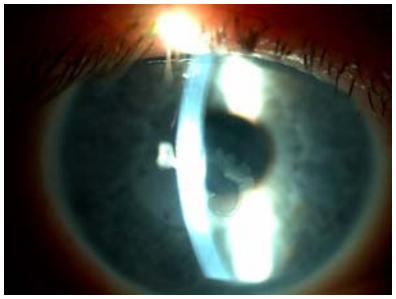
Fuchs' Endothelial Corneal Dystrophy



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Fuchs' Endothelial Corneal Dystrophy

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Fuchs' Endothelial Corneal Dystrophy

- Management
  - NaCl
  - Blow dry
  - BSCL
  - PKP
  - DLEK
  - DSEK
  - DSAEK
- ICD-9 = 371.57 (Endothelial Corneal Dystrophy)

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Posterior Polymorphous Corneal Dystrophy

- Also known as:
  - PPCD
  - Posterior polymorphous dystrophy
  - MIM #122000
  - MIM #609140
  - MIM #609141

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Posterior Polymorphous Corneal Dystrophy

- IC3D Category: 1 or 2 (depending on variant)
- Genetically
  - AD
  - Genes
    - TCF8
    - VSX1, COL8A2 (?)
- Anatomically
  - Descemet's membrane
  - Endothelium
- Histologically
  - Replacement of corneal endothelial with cells having epithelial attributes

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Posterior Polymorphous Corneal Dystrophy

- Clinically
  - Onset – first decade
  - Aggregates of vesicles bordered by gray haze
  - Aggregates may appear like Swiss cheese
  - Refractile appearance on retro-illumination
  - Rarely symptomatic
  - Occasionally, corneal endothelial decompensation/edema
  - Peripheral anterior synechiae are possible

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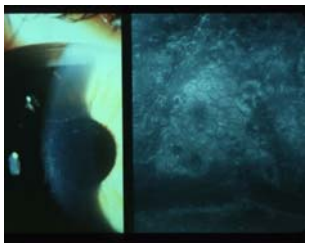
Posterior Polymorphous Corneal Dystrophy



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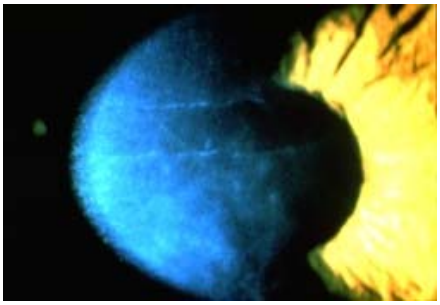
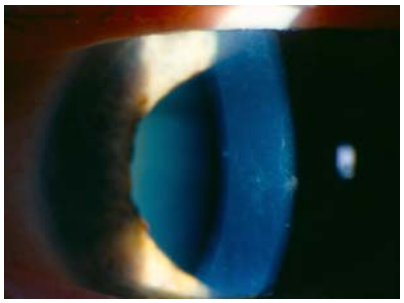
Posterior Polymorphous Corneal Dystrophy



SCHOOL OF OPTOMETRY INDIANA UNIVERSITY Bloomington 81

Posterior Polymorphous Corneal Dystrophy



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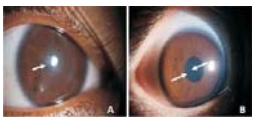
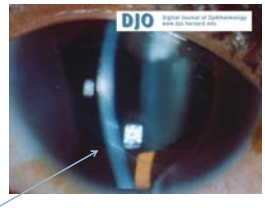
Posterior Polymorphous Corneal Dystrophy

Descemet Membrane Scars From Forceps Delivery



http://www.indianpediatrics.net/feb2013/feb-257b.htm

Haab's Striae



http://www.djo.harvard.edu/site.php?url=/physicians/kr/635&page=KR_AN

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Posterior Polymorphous Corneal Dystrophy

- Management
  - NaCl
  - Blow dry
  - BSCL
  - PKP
  - DLEK
  - DSEK
  - DSAEK
  - May recur
- ICD-9 = 371.58 (Other Posterior Corneal Dystrophies)

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Congenital Hereditary Endothelial Corneal Dystrophy

- Also known as:
  - Congenital hereditary endothelial dystrophy type 1
    - CHED 1
    - Autosomal dominant CHED
    - MIM #121700
  - Congenital hereditary endothelial dystrophy type 2
    - CHED 2
    - Maumenee corneal dystrophy
    - Autosomal recessive CHED
    - Infantile hereditary endothelial dystrophy
    - MIM #217700

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Congenital Hereditary Endothelial Corneal Dystrophy

- IC3D Category: 2
- Genetically
  - Rare!
  - CHED 1 – AD
  - CHED 2 – AR
  - Genes
    - CHED 1 – Unknown
    - CHED 2 - SLC4A11
- Anatomically
  - Endothelial
- Histologically
  - Endothelial cells - scant or degenerated

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Congenital Hereditary Endothelial Corneal Dystrophy

- Clinically
  - Onset
    - CHED 1 – By year 2; progression over 5-10 years
    - CHED 2 – At birth; stationary
  - Corneal edema
    - Diffuse, ground glass appearance to cornea
    - Corneal thickness 2X to 3X normal
  - Photophobia
  - Tearing
  - Nystagmus in CHED 2
  - Mimics congenital glaucoma

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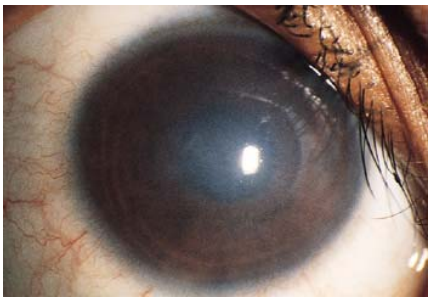
Congenital Hereditary Endothelial Corneal Dystrophy



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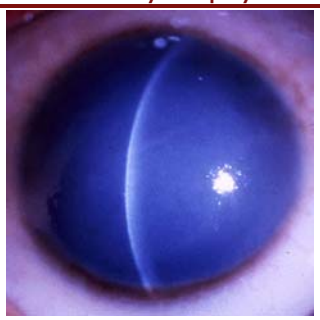
Congenital Hereditary Endothelial Corneal Dystrophy



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Congenital Hereditary Endothelial Corneal Dystrophy

- Management
  - PKP is primary management modality
- ICD-9 = 371.58 (Other posterior corneal dystrophies)

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The End

Thank You
Questions?

Credits

Updated: September 24, 2014
Software: Microsoft PowerPoint
Adobe Captivate

Further Information

http://www.cnpg.com/video/651/Descemet%27s-Stripping-Automated-Endothelial-Keratoplasty-%28DSAEK%29-Techniques,-Tips-And-Ways-to-Prevent-Dislocation.aspx

Anterior Corneal Dystrophies

Thiel-Behnke dystrophy (TBCD)
Gelatinous drop-like corneal dystrophy (GDCD)
Lisch epithelial corneal dystrophy (LECD)
Epithelial recurrent erosion dystrophy (ERED)
Subepithelial mucinous corneal dystrophy (SMCD)

Thiel-Behnke Dystrophy

- Also known as:
  - TBCD
  - Corneal dystrophy of Bowman layer type II
  - Honeycomb corneal dystrophy
  - Anterior limiting membrane dystrophy type II
  - Curly fibers corneal dystrophy
  - Waardenburg-Jonker corneal dystrophy
  - MIM %602082

Thiel-Behnke Dystrophy

- Genetically
  - AD
  - Gene
    - TGFBI
- Anatomically
- Histologically
- Clinically
  - Findings
- Management

Gelatinous Drop-Like Corneal Dystrophy

- Also known as:
  - GDCD
  - Subepithelial amyloidosis
  - Primary familial amyloidosis
  - MIM #204870

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Gelatinous Drop-Like Corneal Dystrophy

- Genetically
  - AR
  - Gene
    - TACSTD2 (M1S1)
- Anatomically
- Histologically
- Clinically
  - Findings
- Management

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Lisch Epithelial Corneal Dystrophy

- Also known as:
  - LECD
  - Band-shaped and whorled microcystic dystrophy of the corneal epithelium

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Lisch Epithelial Corneal Dystrophy

- Genetically
  - XR
  - Gene
    - Unknown
- Anatomically
- Histologically
- Clinically
  - Findings
- Management

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Epithelial Recurrent Erosion Dystrophy

- Also known as:
  - ERED
  - Recurrent hereditary corneal erosions
  - Dystrophia Helsinglandica
  - Dystrophia Smolandiensis
  - MIM %122400

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Epithelial Recurrent Erosion Dystrophy

- Genetically
- Anatomically
- Histologically
- Clinically
  - Findings
  - Management

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Subepithelial Mucinous Corneal Dystrophy

- Also known as:
  - SMCD

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Subepithelial Mucinous Corneal Dystrophy

- Genetically
- Anatomically
- Histologically
- Clinically
  - Findings
  - Management

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Stromal Corneal Dystrophies

Schnyder corneal dystrophy (SCD)
Fleck corneal dystrophy (FCD)
Congenital stromal corneal dystrophy (CSCD)
Posterior amorphous corneal dystrophy (PACD)

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Schnyder Corneal Dystrophy

- Also known as:
  - SCD
  - Schnyder crystalline corneal dystrophy
  - Crystalline stromal dystrophy
  - Schnyder crystalline dystrophy sine crystals
  - Hereditary crystalline stromal dystrophy of Schnyder
  - MIM #121800

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Schnyder Corneal Dystrophy

- Genetically
- Anatomically
- Histologically
- Clinically
  - Findings
- Management

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Fleck Corneal Dystrophy

- Also known as:
  - FCD
  - Francois-Neetens speckled corneal dystrophy
  - MIM #121850

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Fleck Corneal Dystrophy

- Genetically
- Anatomically
- Histologically
- Clinically
  - Findings
- Management

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Congenital Stromal Corneal Dystrophy

- Also known as:
  - CSCD
  - Congenital hereditary stromal dystrophy
  - Witschel dystrophy
  - MIM #610048

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Congenital Stromal Corneal Dystrophy

- Genetically
- Anatomically
- Histologically
- Clinically
  - Findings
- Management

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Posterior Amorphous Corneal Dystrophy

- Also known as:
  - PACD
  - Posterior amorphous stromal dystrophy

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Posterior Amorphous Corneal Dystrophy

- Genetically
- Anatomically
- Histologically
- Clinically
  - Findings
- Management

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Posterior Corneal Dystrophies

X-linked endothelial corneal dystrophy (XECD)

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X-Linked Endothelial Corneal Dystrophy

- Also known as:
  - XECD

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X-Linked Endothelial Corneal Dystrophy

- Genetically
- Anatomically and Histologically
- Clinically
  - Findings
- Management

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Stromal Puncture

Image courtesy of Lorie A. Logan, O.D.

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Stromal Puncture

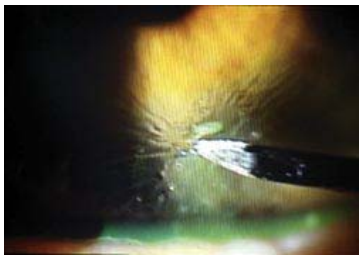

Image courtesy of Lorie A. Logan, O.D.

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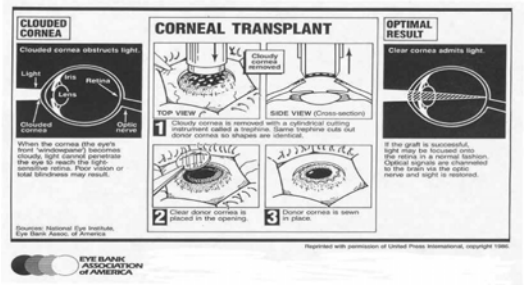
Penetrating Keratoplasty



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Penetrating Keratoplasty

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