



No Tears Left to Cry: Restoring the Ocular Surface

Laura Goldberg, OD, MA, FAAO, ABO
Wilmer Eye Institute, Johns Hopkins

Learning Objectives

01

Define dry eye disease per TFOS DEWS III

02

Recognize epidemiology, risk factors, and tear film physiology (lacrima I functional unit)

03

Apply a structured diagnostic approach using symptoms and objective signs

04

Differentiate dry eye subtypes based on underlying mechanisms

05

Develop stepwise, individualized management plans, including emerging therapies

- I have no financial disclosures

Dry Eye Disease

DEWS III Definition

Dry Eye is a multifactorial disease characterized by:



Tear Film
Instability

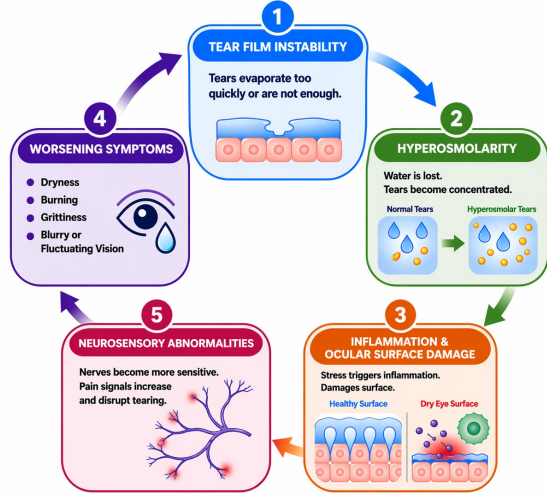


Ocular
Inflammation



Neurosensory
Abnormalities

Dry Eye Disease: The Vicious Cycle

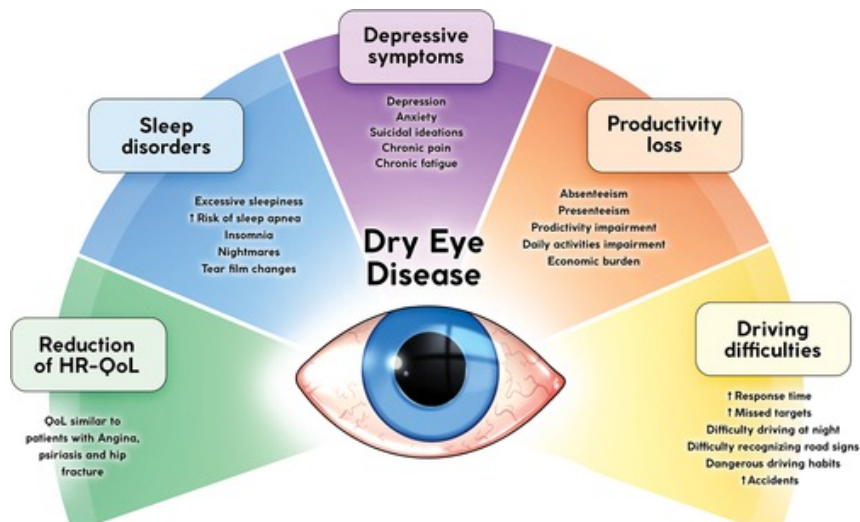


The Burden of Dry Eye Disease



- Dry eye disease is one of the most **common** ocular conditions worldwide
- Approximately **16 million** adults in the United States have diagnosed dry eye disease
- Up to 30 million Americans report symptoms of dry eye
- Dry eye disease contributes to increased healthcare utilization, reduced workplace productivity, and decreased quality of life

Impact on Quality of Life







High-Risk Populations

- Postmenopausal women
- Contact lens wearers
- Individuals with autoimmune disease
- Patients with heavy digital device use
- Medications associated with risk

Postmenopausal Women and Dry Eye



-  **Decreased estrogen and androgen levels affect tear film stability**
-  **Androgen deficiency** → reduced meibomian gland function ↑ evaporation
-  **Hormonal changes** → decreased tear production
-  **Increased ocular surface inflammation**

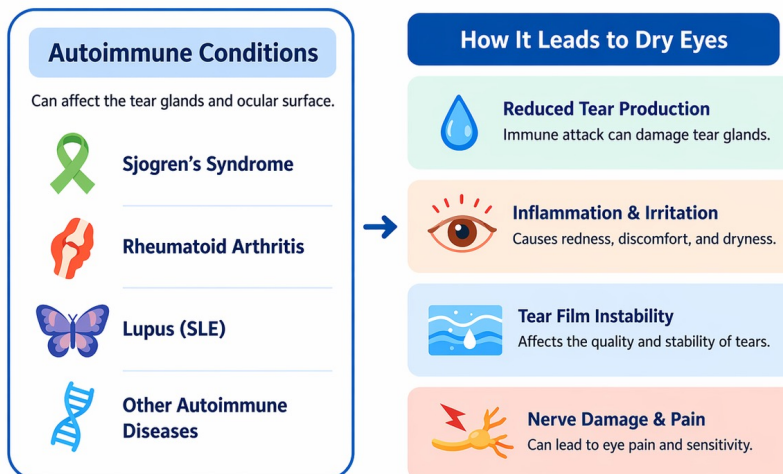


Contact Lens Induced Dry Eye

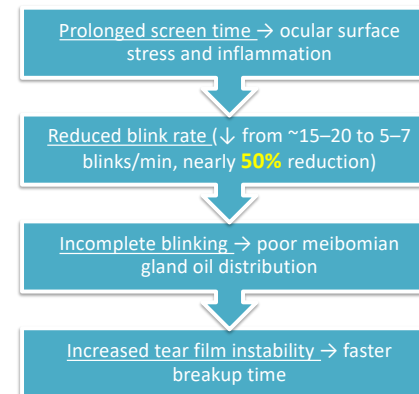
- **Disrupt tear film** → split into pre- and post-lens layers
- **Increase evaporation** → reduced lipid layer stability
- **Reduce tear exchange** → debris and inflammatory buildup
- **Alter blinking** → more incomplete blinks
- Contribute to **meibomian gland dysfunction** with long-term wear

Autoimmune Conditions & Dry Eyes

Autoimmune diseases can affect the tear glands and ocular surface, leading to chronic dry eye symptoms.



Digital Device Use and Dry Eye

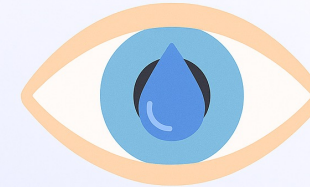


Medication-Induced Dry Eye

- **Common medication types:**
 - **Antihistamines** → reduce tear secretion
 - **Antidepressants (SSRIs, TCAs)** → anticholinergic effects ↓ tears
 - **Decongestants** → drying effect on mucous membranes
 - **Isotretinoin** → affects meibomian gland function (↑ evaporation)
 - **Beta-blockers & diuretics** → reduce aqueous production
 - **Hormonal therapies** → alter tear film balance



Function of the Tear Film

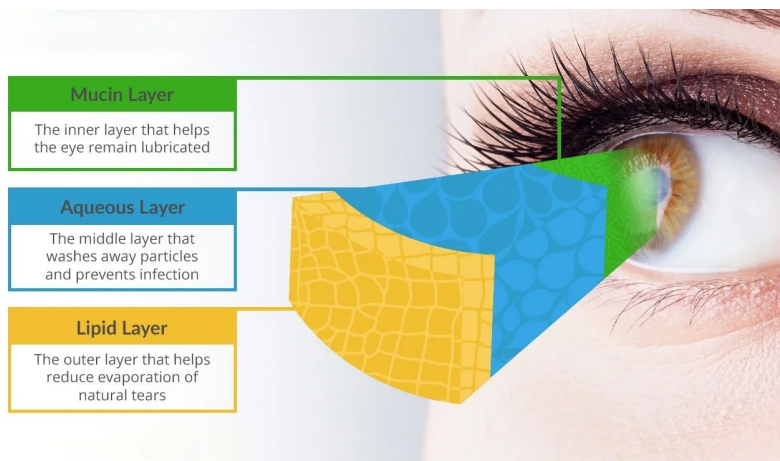


Lubrication
Keeps the eye's surface smooth and moist

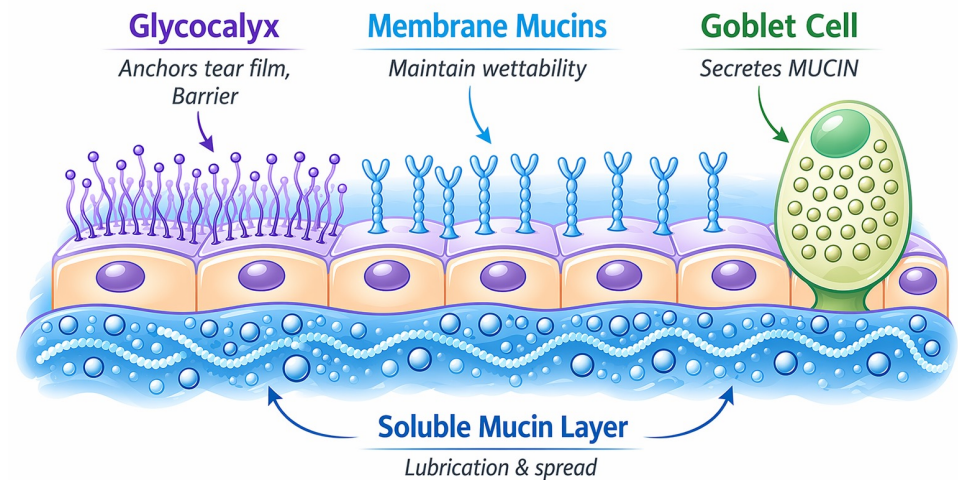
Protection
Prevents infection and removes debris

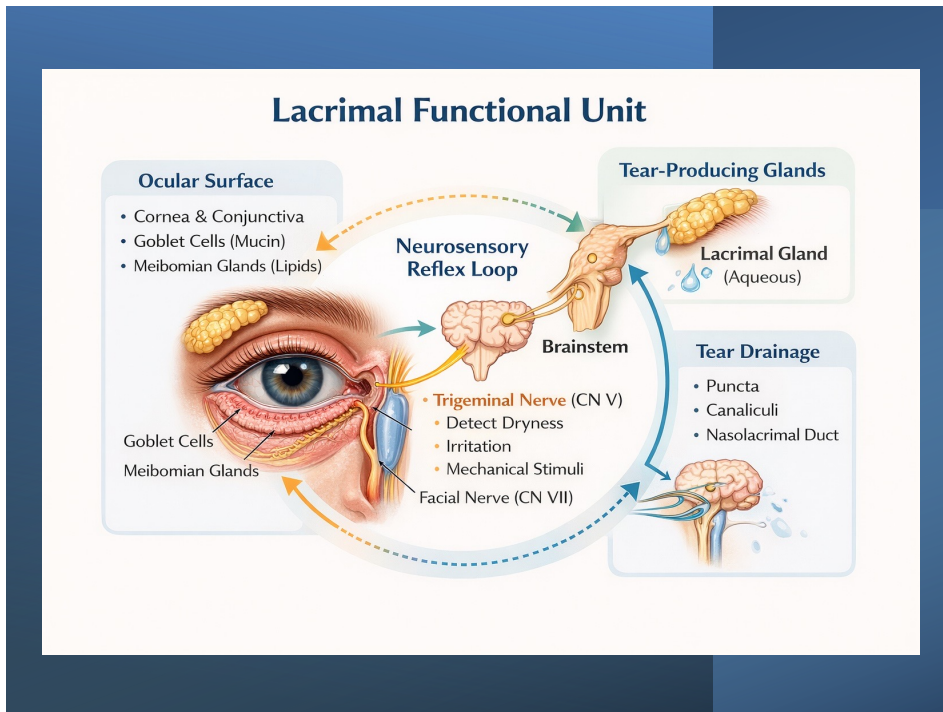
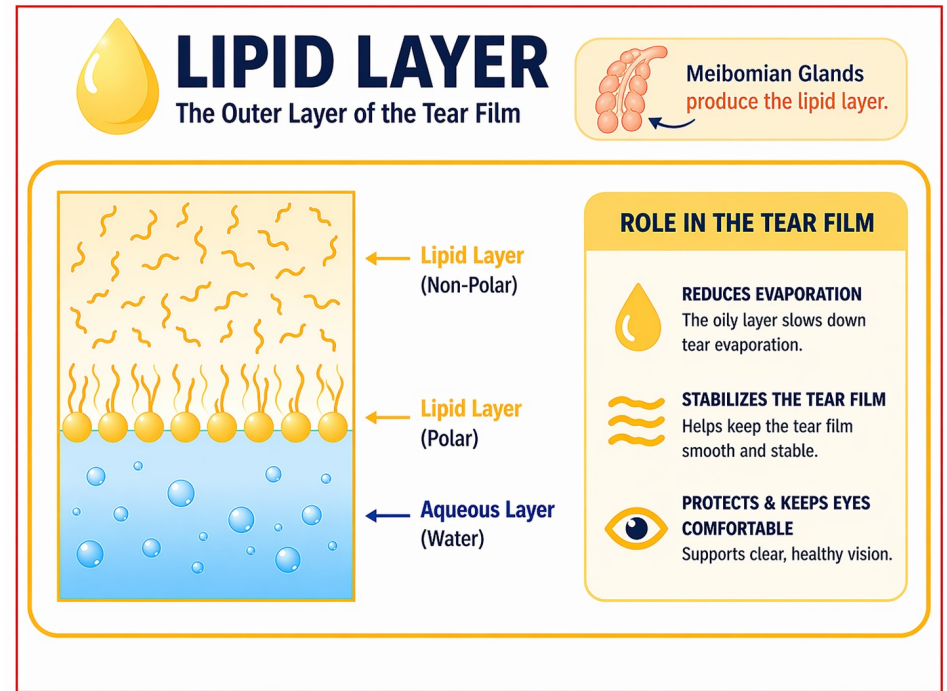
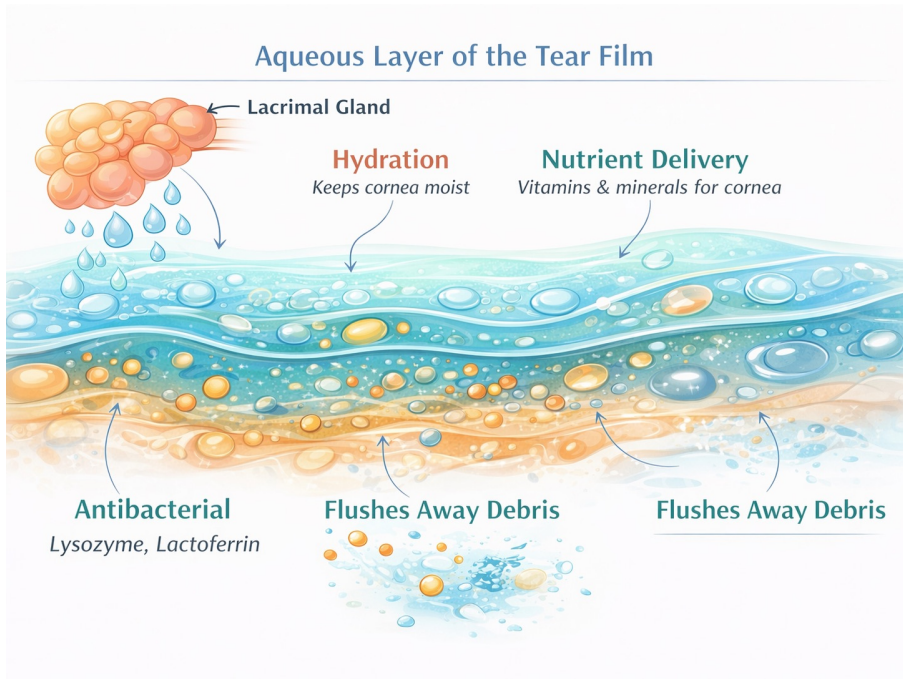
Nourishment
Delivers essential nutrients for eye health

Layers of the Tear Film



Mucin Layer





Diagnostic Criteria for DED (TFOS DEWS III)

Screening Questionnaire

	Constantly	Frequently	Often	Sometimes	Never
1. Have you experienced any of the following during a typical day within the last month?					
1. Eyes that are sensitive to light?	4	3	2	1	0
2. Vision blurring between blinks (with or without refractive correction if needed)?	4	3	2	1	0
Symptoms and visual disturbance subscale					
3. Have problems with your eyes limited you in performing any of the following during a typical day within the last month?					
3. Driving or being driven at night?	4	3	2	1	0
4. Watching TV, or a similar task?	4	3	2	1	0
Visual function / tasks subscale					
5. Have your eyes felt uncomfortable in any of the following situations during a typical day within the last month?					
5. Windy conditions?	4	3	2	1	0
6. Places or areas with low humidity?	4	3	2	1	0
Environmental subscale					
OSDI-6 cutoff ≥ 4					

+ 1 of

Tear Film Markers

Non-invasive tear breakup time: $<10s$
[fluorescein tear breakup time: $<5s$]

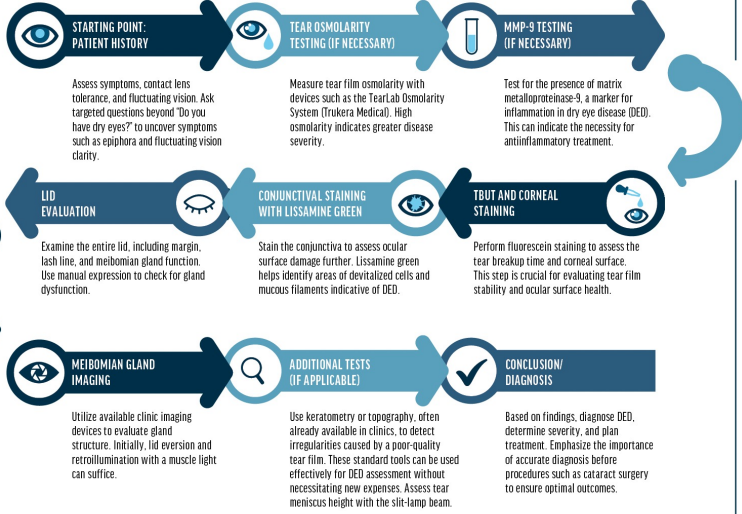
OR

Osmolarity (≥ 308 mOsm/L in higher eye or interocular difference > 8 mOsm/L)

Ocular Surface Staining

- Cornea: > 5 punctate spots and/or
- Conjunctiva: >9 punctate spots and/or
- Lid margin: ≥ 2 mm length & $\geq 25\%$ width

STEP-BY-STEP DED DIAGNOSTIC WORKFLOW



PATIENT HISTORY: THE FOUNDATION OF DRY EYE DIAGNOSIS

A thorough history helps uncover symptoms, identify risk factors, and guide a targeted evaluation and treatment plan.



WHY IT MATTERS	KEY QUESTIONS TO ASK	RISK FACTORS TO UNCOVER
<p>Guides the Workup Helps determine which tests and exams are most relevant.</p> <p>Identifies the Cause Reveals risk factors, underlying conditions, and contributing medications or environment.</p> <p>Shapes Treatment Supports personalized and effective management.</p>	<p>SYMPTOMS Do your eyes feel dry, gritty, or burning? Is your vision blurry or fluctuating? Are you sensitive to light? Do your eyes water or tear excessively?</p> <p>ONSET & COURSE When did symptoms start? Are they constant or do they come and go?</p> <p>MEDICATIONS Do you take any medications, including over-the-counter, hormonal, or acne treatments?</p> <p>ENVIRONMENT & LIFESTYLE How much screen time do you have? Are you in dry, windy, or air-conditioned environments? Do you wear contact lenses?</p> <p>MEDICAL HISTORY Do you have autoimmune conditions, thyroid disease, allergies, or have you had eye surgery?</p>	<p>Female & Post-Menopausal Status</p> <p>Autoimmune Disease</p> <p>Medications (Antihistamines, Antidepressants, Isotretinoin, etc.)</p> <p>Prolonged Screen Use</p> <p>Dry, Windy, or Air-Conditioned Environments</p> <p>Contact Lens Wear</p>

KEY TAKEAWAY Listening closely to your patients provides critical clues that lead to accurate diagnosis and better outcomes in dry eye.

DRY EYE SYMPTOMS

Symptoms can vary from person to person.

<p>DRYNESS A gritty, scratchy, or sandy feeling.</p>	<p>BURNING A stinging or burning sensation.</p>	<p>BLURRY OR FLUCTUATING VISION Vision that comes and goes.</p>	<p>LIGHT SENSITIVITY Discomfort in bright lights.</p>	<p>EYE FATIGUE Tired or strained eyes.</p>
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Dry Eye Symptoms Questionnaires

Ocular Surface Disease Index 6: OSDI 6
Prof. Dr. Heiko Pult & Prof. Dr. James Wolffsohn

Please answer the following questions by circling the numbers in the boxes.

Question	0	1	2	3	4
Have you experienced any of the following during a typical day of the last month?					
1. Eyes that are sensitive to light?	4	3	2	1	0
2. Vision blurring between blinks, with your refractive correction?	4	3	2	1	0
Have problems with your eyes limited you in performing any of the following during a typical day of the last month?					
3. Driving or being driven at night?	4	3	2	1	0
4. Watching TV, or a similar task?	4	3	2	1	0
Have your eyes felt uncomfortable in any of the following situations during a typical day of the last month?					
5. Windy conditions?	4	3	2	1	0
6. Places or areas with low humidity?	4	3	2	1	0

Sum of all questions: _____
Likely dry eye if total sum ≥ 4

Normal ← 4 → Dry Eye

SPEED™ QUESTIONNAIRE

Name: _____ Date: _____ Sex: M / F Ethnic: _____

For the Standardized Patient Evaluation of Dry Eye (SPEED) Questionnaire, please answer the following questions by circling the best answer that applies to you. Select only one answer per question.

1. Repeat the type of **SYMPTOMS** you experience and when they occur:

Symptoms	Never	Rarely	Sometimes	Often	Very Often
Constant Irritation or Stinging					
Constant or Intermittent Blurred or Fluctuating Vision					
Constant or Intermittent Eye Itching					

2. Repeat the **FREQUENCY** of your symptoms using the rating list below:

Symptoms	0	1	2	3
Constant Irritation or Stinging				
Constant or Intermittent Blurred or Fluctuating Vision				
Constant or Intermittent Eye Itching				

3. Repeat the **SEVERITY** of your symptoms using the rating list below:

Symptoms	0	1	2	3	4
Constant Irritation or Stinging					
Constant or Intermittent Blurred or Fluctuating Vision					
Constant or Intermittent Eye Itching					

4. Dry eye can mean things for lubrication? YES NO If yes, how often?

For all questions, 0 = Not at all, 1 = Mild, 2 = Moderate, 3 = Severe, 4 = Very Severe

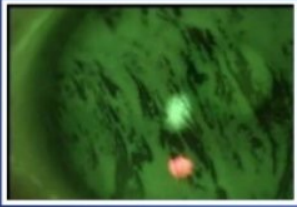
SANDE Questionnaire

PLEASE COMPLETE THE FOLLOWING QUESTIONS REGARDING THE FREQUENCY AND SEVERITY OF YOUR DRY EYE SYMPTOMS.

1. Frequency of symptoms: Please place an "X" on the line to indicate how often, on average, your eyes feel dry and/or irritated: _____ All the time

2. Severity of symptoms: Please place an "X" on the line to indicate how severe, on average, you feel your symptoms of dryness and/or irritation: _____ Very Mild

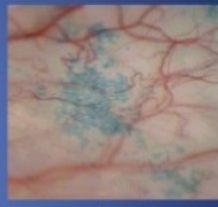
Dry Eye Signs/Diagnostic Tools



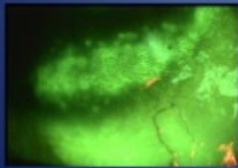
Tear Film Break-Up Time (BUT)



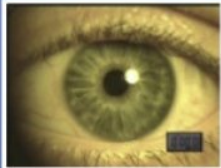
Rose Bengal Staining



Lissamine Green Staining



Fluorescein Staining



Blink Rate

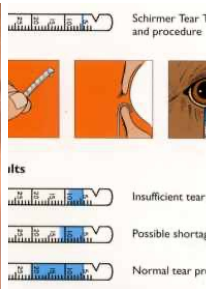


Schirmer Testing



Osmolarity

Tear Film Evaluation



Schirmer's Testing

Schirmer I (without anesthesia)	Schirmer II (with anesthesia)
basic and reflex secretion	basic secretion
If wetting >10mm = normal eye	If Wetting <10mm then irritate the nasal mucosa with cotton bud & note the wetting after 2 min.
10mm = mild dry eye	If no Wetting or <1mm - Sjogren's syndrome
5-10mm = moderate dryeye	If Wetting increases by 1mm Non-Sjogren's syndrome
3-5 mm = severe dryeye	
<3mm = very severe dryeye	

Tear Osmolarity Testing



Tear Osmolarity Criteria

Measurement	Interpretation
<308 mOsm/L	Normal
≥308 mOsm/L	Hyperosmolar
>8 mOsm/L difference	Tear instability

MMP9 Testing

INFLAMMADRY DRY EYE TEST

POSITIVE

Strong positive: Both lines are dark red/pink.

Positive: Test line is lighter than control line.

Weak positive: Test line is very faint but visible.

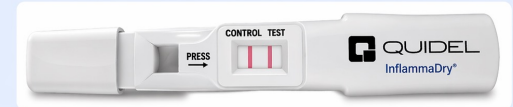
NEGATIVE

Negative: Only the control line appears.

INVALID

Invalid: No lines appear. Repeat the test.

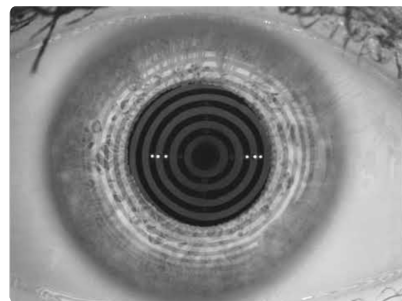
Apply the tip to the lower conjunctiva. Read results in 10 minutes.



HOW DO WE DIAGNOSE DRY EYE?

- Look for inflammation.** Dry eye often involves inflammation that standard tests may miss.
- Use objective tests.** InflammADry detects MMP-9, a marker of inflammation, from a quick and easy lower lid swab.
- Guide treatment.** Knowing if inflammation is present helps us choose the right therapies and improve outcomes.

Invasive vs. Non-Invasive TBUT

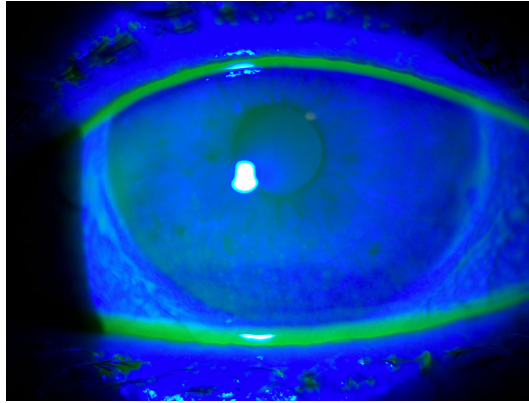


NORMAL vs. ABNORMAL TBUT

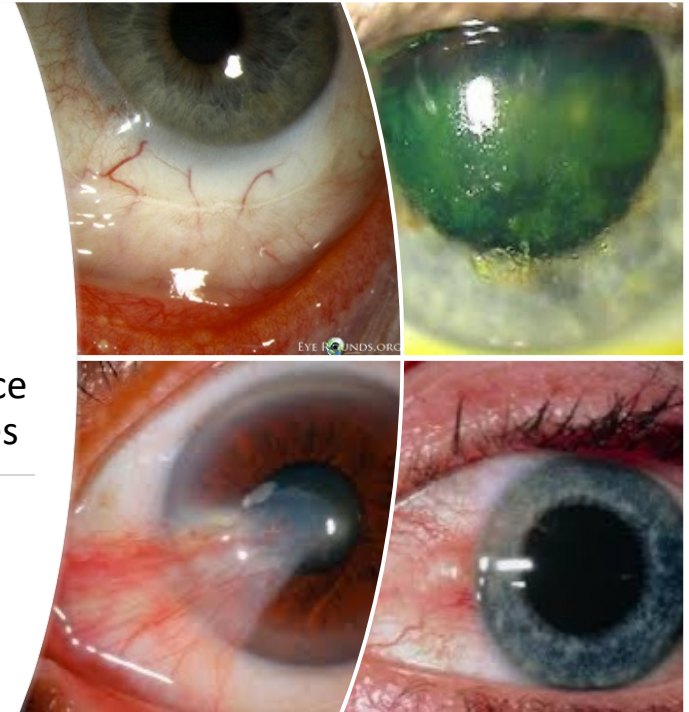
(Tear Break-Up Time)

NORMAL	BORDERLINE	ABNORMAL
10+ Seconds	5-10 Seconds	< 5 Seconds

Tear
Meniscus
Height

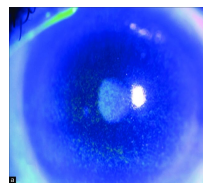


Ocular Surface Abnormalities

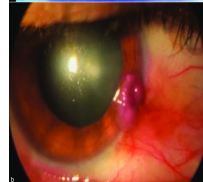


Ocular Surface Evaluation

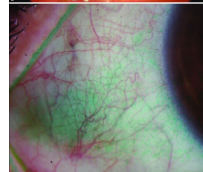
Fluorescein highlights
epithelial disruption
and punctate erosions



Rose bengal stains
damaged cells but may
cause irritation



Lissamine green stains
devitalized epithelial
cells



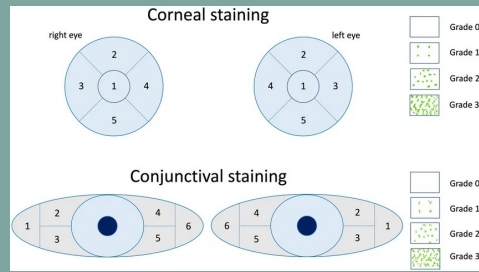
	Pattern	Example
	Diffuse	Viral conjunctivitis Trauma Toxicity
	Inferior	Blepharokeratitis Lagophthalmos Trichiasis
	Interpalpebral	Dry eye disease Exposure Neurotrophic kerat
	Superior	Superior limbic keratoconjunctivitis Foreign body unde Trichiasis
	Superior conjunctivitis	Superior limbic keratoconjunctivitis
	3 and 9 o'clock	Contact lens
	Lower conjunctivitis	Mechanical Meibomian gland dysfunction

Fluorescein Staining Patterns

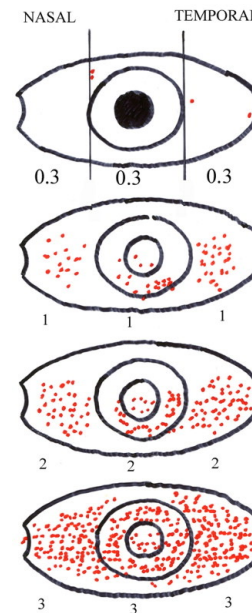
Oxford vs. NEI Staining Score

Grade	Description	Scheme	Clinical image
0	Absent		
I	Minimal		
II	Mild		
III	Moderate		
IV	Marked		
V	Severe	> Grade IV	

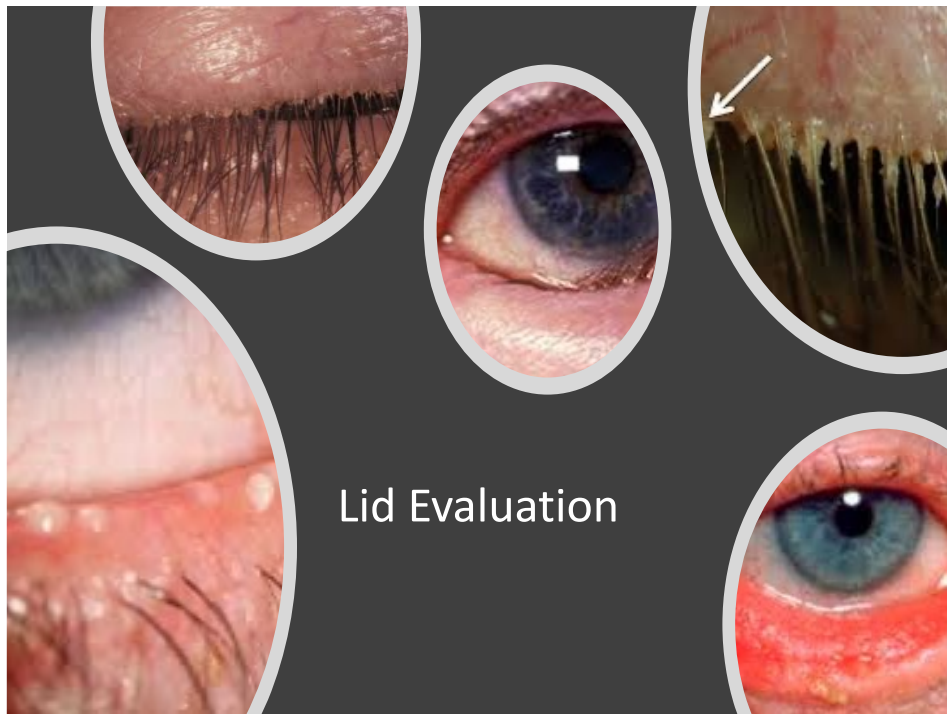
Oxford



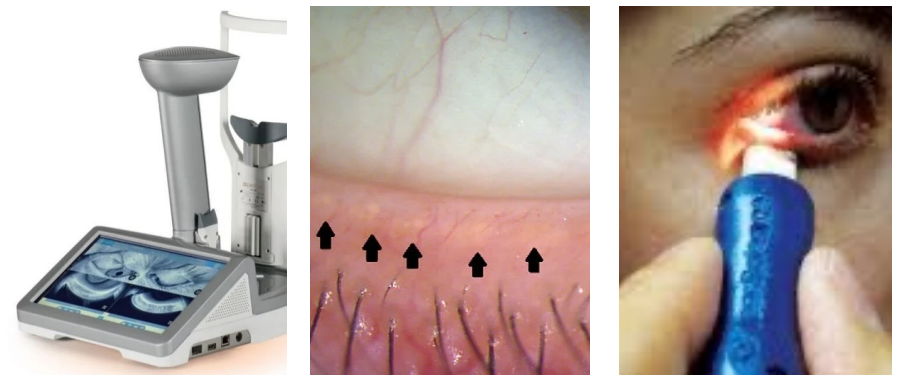
NEI



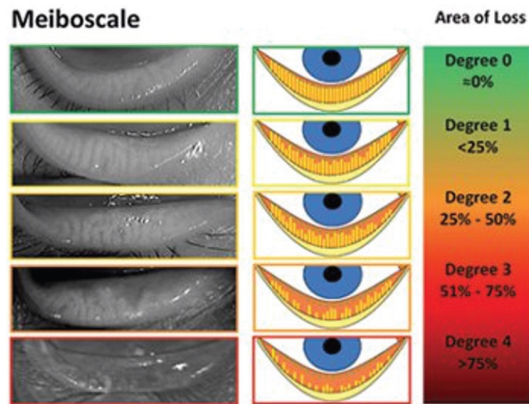
Rose Bengal Staining
Scale: Van Bijsterveld System



Meibomian Gland Evaluation



PULT 5- Meibomian Gland Grading Scale



PROGRESSIVE STAGES OF BLEPHARITIS

Stage 1

Lid margin with minimal scurf, irritation and foreign body (FB) sensation.



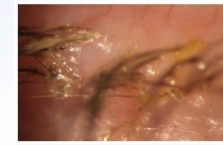
Stage 2

Lid margin with mild scurf, lash matting and follicle swelling, mild inflammation, FB sensation, watery eyes due to over stimulated tear glands.



Stage 3

Lid margin with moderate scurf, lash crusting and follicle swelling, early lash misdirection, moderate inflammation, FB sensation, meibonitis, and early to moderate dry eye. Possible Demodex infestation.



Stage 4

Lid margin with heavy scurf and crusting, lash follicle swelling, lash misdirection, ingrown lashes, severe inflammation with tear gland atrophy, impacted meibomian glands and severe dry eye. Possible Demodex infestation.



BlephEx
Healthy Lids for Life!

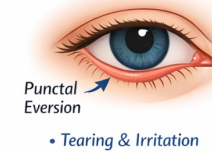
THE FIRST AND ONLY DOCTOR TREATMENT FOR BLEPHARITIS

Demodex (collarette) Grading Scale

Grade 0*	Grade 1*	Grade 2	Grade 3	Grade 4
0-2 lashes/eyelid with collarettes	3-10 lashes/eyelid with collarettes	>10 to <1/3 (-50%) lashes/eyelid with collarettes	≥1/3 to <2/3 (-100%) lashes/eyelid with collarettes	≥2/3 (-150%) lashes/eyelid with collarettes

Stages of Eyelid Ectropion

Stage 1: Mild



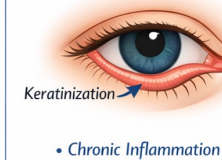
Stage 2: Moderate



Stage 3: Severe



Stage 4: Advanced





Healthy Lid

Inward turning lid

Entropion

Lid Wiper Epitheliopathy

Korb Grading Scale

Grading of linear area of staining of lid wiper

Linear Area of Staining	Grade
< 2 mm	0
2-4 mm	1
5-9 mm	2
≥ 10 mm	3

Based on Korb DR, Greiner JV, Herman JP, Hebert E, Finimore VM, Exford JM, Glonek T, Olson MC. Lid-wiper epitheliopathy and dry-eye symptoms in contact lens wearers. CLAO J 2002;28:211-6.

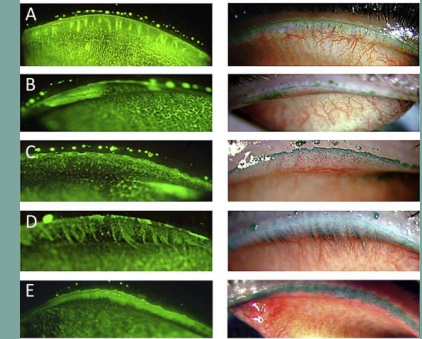
Table 5.2

Grading of severity of staining of lid wiper

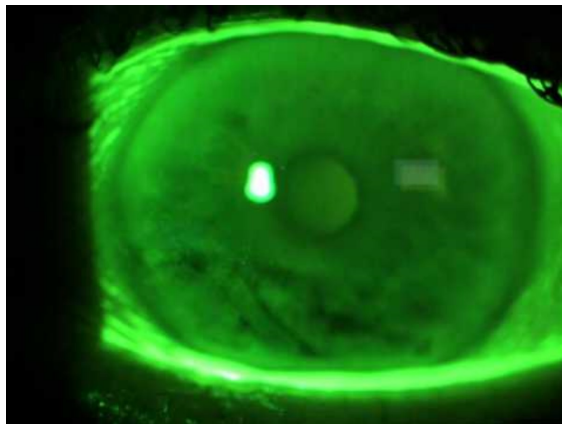
Severity of Staining	Grade
Absent	0
Mild	1
Moderate	2
Severe	3

Based on Korb DR, Greiner JV, Herman JP, Hebert E, Finimore VM, Exford JM, Glonek T, Olson MC. Lid-wiper epitheliopathy and dry-eye symptoms in contact lens wearers. CLAO J 2002;28:211-6.

Flourescein Lissamine green



Incomplete Blink



CAUSES OF INCOMPLETE BLINK

The eyelids don't fully close, leading to poor tear distribution, increased evaporation, and dryness.

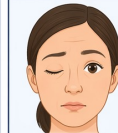
1 REDUCED BLINK RATE AND SCREEN USE



People blink up to 66% less when using digital devices.

Decreased blink frequency and amplitude during prolonged screen time.

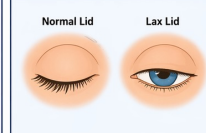
2 FACIAL NERVE PALS (LAGOPHTHALMOS)



Weakness prevents complete eyelid closure.

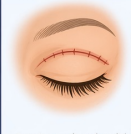
Weakness or paralysis of the orbicularis oculi muscle prevents full closure.

3 EYELID LAXITY OR MALPOSITION



Loose or poorly positioned lids may not meet completely.

4 POST-SURGICAL CHANGES



Scarring can alter lid closure and blink mechanics.

Scarring or altered eyelid anatomy after procedures like blepharoplasty or eyelid surgery can limit full blink.

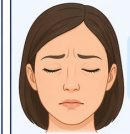
5 ORBICULARIS MUSCLE DYSFUNCTION



Muscle weakness or fatigue can reduce blink completeness.

Neuromuscular disorders, myasthenia gravis, or muscle fatigue can impair blink strength.

6 PAIN, DISCOMFORT, OR OCULAR SURFACE DISEASE



Irritation can cause a reflex change in blink pattern.

Chronic irritation, redness, or dryness can lead to altered or incomplete blinking.

Dry Eye TREATMENTS

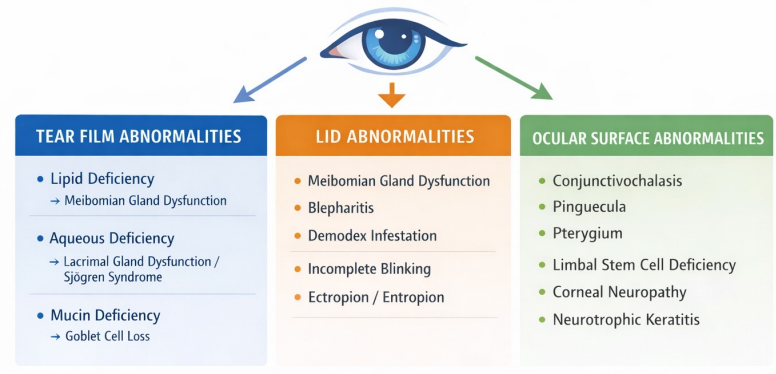
Environmental, Dietary, and Medication Adjustments

Lubricating Treatments

Anti-inflammatory Treatments

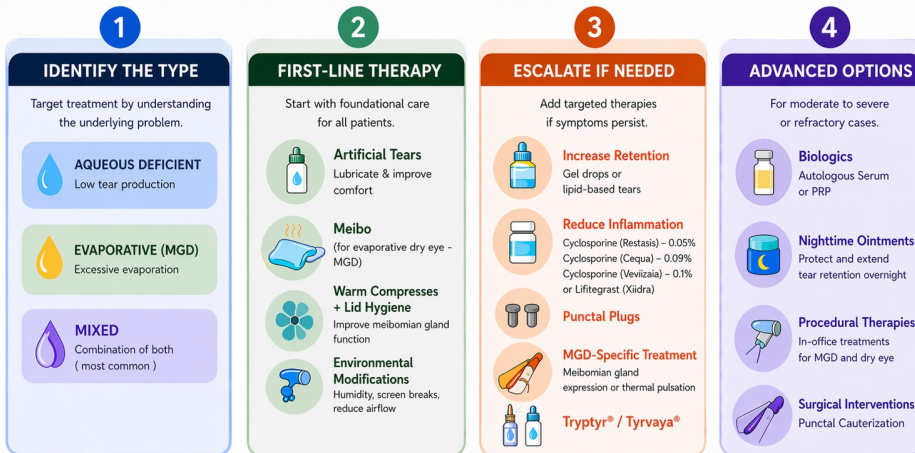
Meibomian Gland Treatments

Etiologic Subclassification of Dry Eye Disease



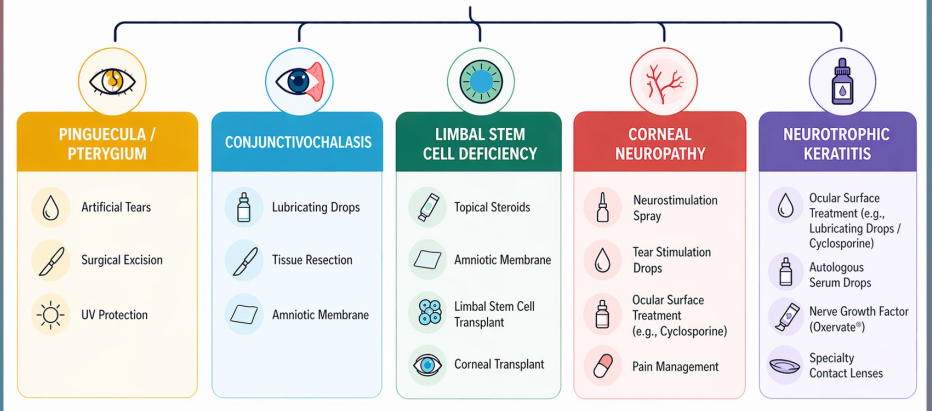
Identifying the **Primary Driver** of Dry Eye Disease

TEAR FILM ABNORMALITIES TREATMENT APPROACH



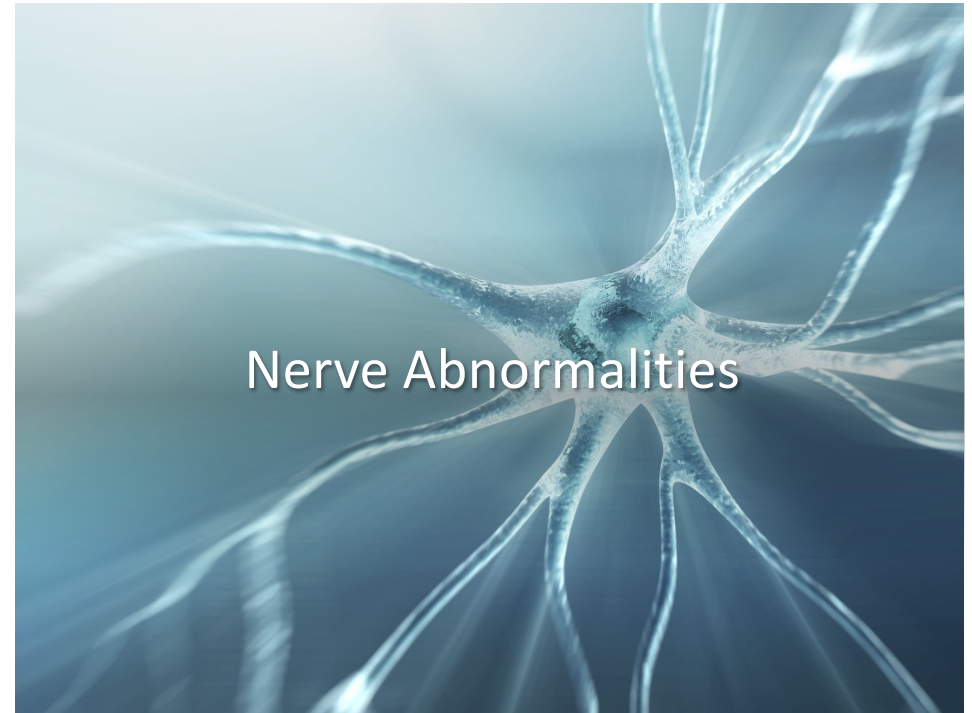
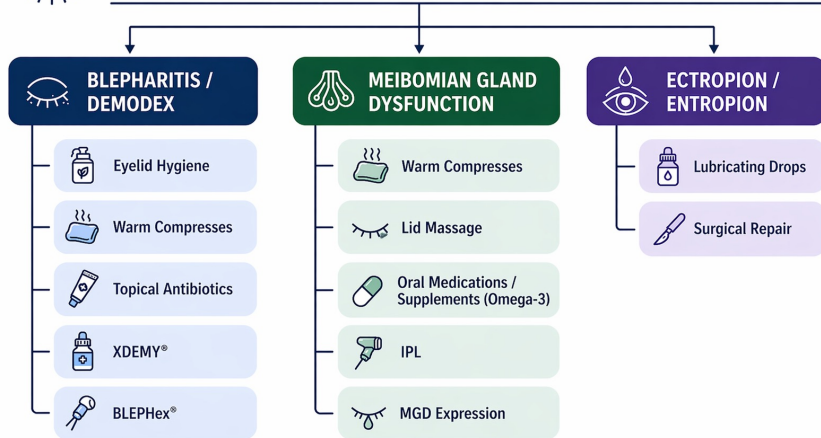
OCULAR ABNORMALITIES: TREATMENT FLOWCHART

Match the treatment to the specific ocular surface abnormality.





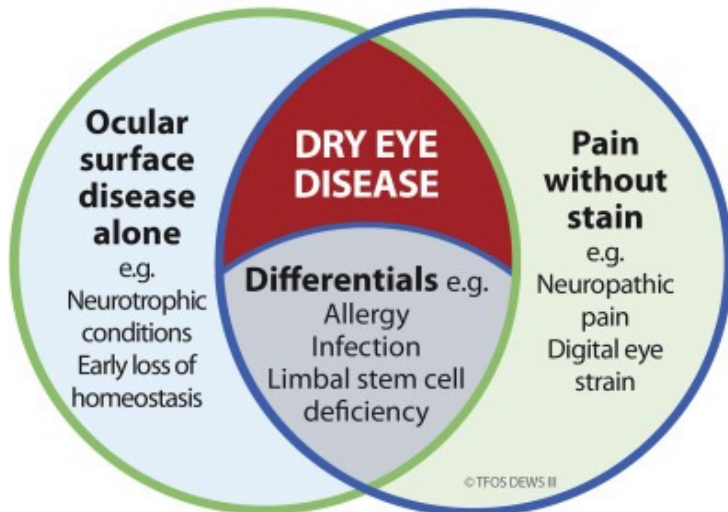
LID ABNORMALITIES: TREATMENT FLOWCHART



Nerve Abnormalities

Signs

Symptoms



Corneal Neuropathy



- Nerve Dysfunction
- Eye Pain & Burning
- Normal Corneal Surface

Symptoms

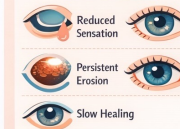


Neurotrophic Keratitis



- Nerve Damage
- Loss of Sensation
- Corneal Ulcers

Symptoms



VS

Key Differences

PAINFUL EYE

Severe Discomfort

NUMB EYE

Minimal Sensation

NORMAL CORNEA

Clear Surface

DAMAGED CORNEA

Ulcers & Erosion

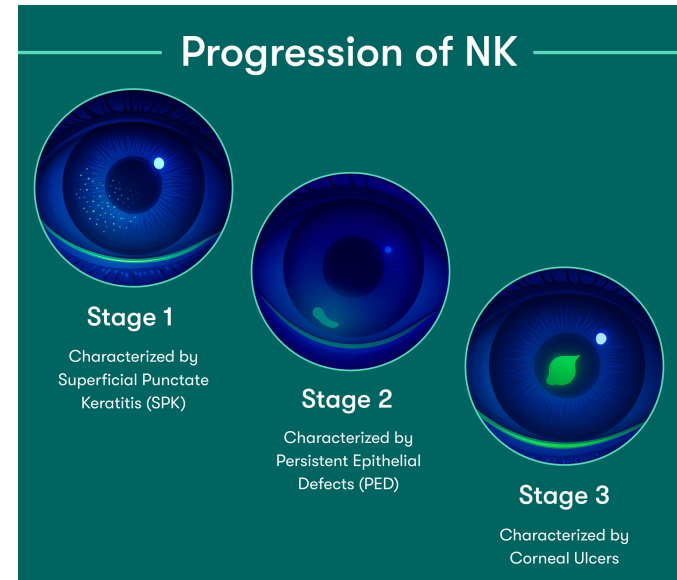
TEAR PRODUCTION

Normal Tearing

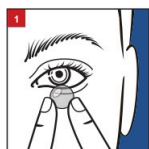
POOR HEALING

Slow Recovery

Neurotrophic Keratitis: Stain without Pain



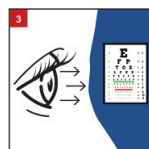
Corneal Sensitivity Testing



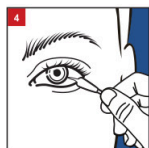
1. Ensure that contact lenses are removed and corneal sensitivity testing is conducted BEFORE administration of anesthetic eye drops.



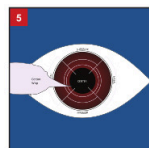
2. Qualitative tools to assess corneal sensitivity: 1) finely tapered cotton swab, 2) dental floss, 3) finely tapered tip of tissue.



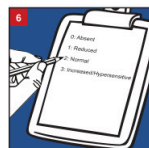
3. Instruct patient to fixate on a target that is straight ahead. Test unaffected eye first.



4. Request that the patient report when they feel the stimulus. Approach the patient's lateral side.



5. Gently touch the stimulus to the center of the cornea and observe the blink reflex; to perform a thorough examination, all quadrants of the cornea should be tested.







6. Record corneal sensitivity of each eye using a 0-3 scale:
0: Absent
1: Reduced
2: Normal
3: Increased/Hypersensitive

Tools for Corneal Sensitivity

NEUROTROPHIC KERATITIS

CAUSES

-  Herpes Zoster / Herpes Simplex
-  Diabetes
-  Neurological Conditions
-  Eye Surgery / Trauma



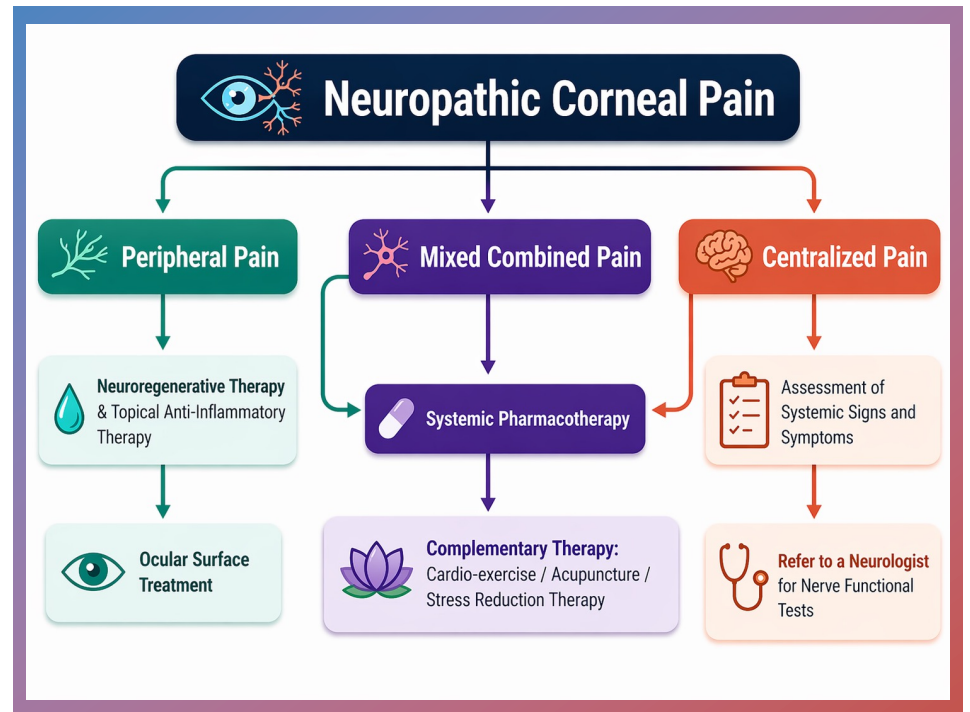
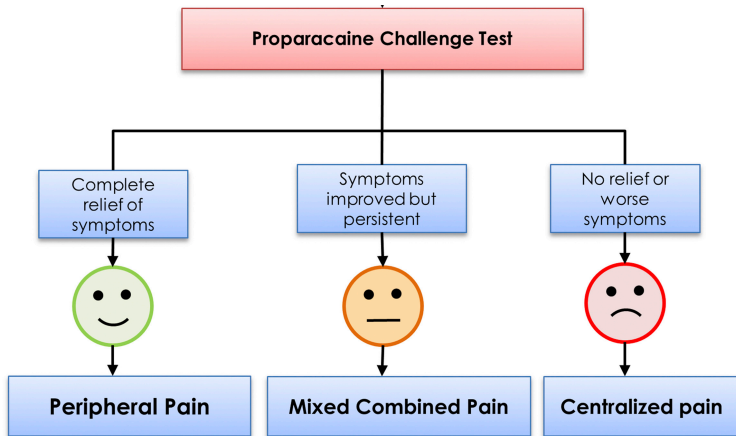
TREATMENTS

-  Cyclosporine Drops / Heavy Lubrication
-  Autologous Serums
-  Amniotic Membrane
-  Therapeutic Contact Lenses
-  Neurotrophic Growth Factors (Oxervate®)



Corneal Neuropathy: Pain without Stain

Is it Central or Peripheral Pain?



Corneal Neuropathy: Causes & Treatment

COMMON CAUSES

-  **Surgical / Iatrogenic**
LASIK, PRK, CXL
-  **Ocular Surface Disease**
Chronic Dry Eye, MGD
-  **Infectious**
Herpes Keratitis, Zoster
-  **Systemic Neuropathic Conditions**
Diabetes, Sjögren's
-  **Toxic / Medication-Induced**
Topical Anesthetics, Preserved Drops
-  **Central Sensitization**
Chronic Pain Syndromes








Nerve Damage Can Lead to:
Burning, Pain, Photophobia

TREATMENT APPROACH

-  **Ocular Surface Treatment**
 - Artificial Tears
 - Lid Hygiene
-  **Nerve Regeneration / Neurostimulation**
 - **Tyrvaya®**
(varenicline nasal spray)
-  **Tear Stimulation**
 - **Tryptyr®**
(acoltremon ophthalmic solution 0.003%)
-  **Neuropathic Pain Management**
 - Gabapentin
 - TCAs / SNRIs
-  **Central Sensitization**
 - Pain Specialist
 - Cognitive Therapy

Future Directions in Dry Eye Disease

-  **Improved diagnostic tools** such as tear inflammatory biomarkers
-  **Advanced meibography imaging**
-  **Corneal nerve imaging**
-  **Personalized treatment approaches**
-  **Regenerative therapies** and novel pharmacologic agents

Summary and Key Clinical Takeaways

Better Understanding. Better Care.

-  **01 DRY EYE IS COMPLEX**
Dry eye disease is a multifactorial, chronic ocular surface disease.
-  **02 DIAGNOSIS TAKES MORE THAN SYMPTOMS**
Accurate diagnosis requires symptoms plus objective evidence of tear film imbalance.
-  **03 IDENTIFY THE DRIVERS**
Tear film abnormalities, lid disease, and ocular surface issues are the primary disease drivers.
-  **04 SYMPTOMS DON'T ALWAYS MATCH**
Symptoms and clinical findings may not always correlate.
-  **05 TREATMENT SHOULD BE PERSONALIZED**
Effective management requires individualized and multimodal treatment strategies.

KEY TAKEAWAY:
Understand the complexity. Look beyond the surface.
Personalize the plan. Improve the outcomes.








THANK YOU!



EMAIL: LGOLDB23@JH.EDU

CORNEAL NERVE IMAGING: CONFOCAL MICROSCOPY COMPARISON

FEATURE	CORNEAL NEUROPATHY <small>Neuropathic Pain</small>	NEUROTROPHIC KERATITIS <small>Neurotrophic Disease</small>
 NERVE DENSITY	Normal or Increased Early	Decreased
 NERVE SHAPE	Tortuous and Irregular <small>Twisted, beaded, abnormal</small>	Straight and Simplified <small>Thin, less branching</small>
 MICRONEUROMAS	Present <small>Common finding</small>	Absent
 BRANCHING	Normal or Increased <small>Chaotic or Excessive</small>	Reduced <small>Loss of normal branching</small>
 CLINICAL PRESENTATION	"Pain Without Stain" <small>Severe pain, minimal signs</small>	"Stain Without Pain" <small>Surface damage with little to no symptoms</small>

