Dry Eye

Learning Objectives

At the end of this class the students shall be able to :

- Define dry eye disease.
- Understand predisposing and aetiological factors responsible for dry eye disease
- Comprehend clinical features and tests for the above condition
- Understand fundamentals of managing dry eye depending on the severity of disease

What is Dry Eye Disease?

- Dry eye disease (DED) is a condition caused by many factors that result in inflammation of the eye and tear-producing glands.
- Inflammation can decrease the ability of the eye to produce normal tears that protect the surface of the eye and keep it moist and lubricated.

Definition

- Dry eye is not a trivial complaint. It can cause significant discomfort and affect quality of life significantly.

- In 1995 the National Eye Institute defined dry eye disease (DED) as *" a disorder of the tear film due to tear deficiency or excessive tear evaporation which causes damage to the interpalpebral ocular surface and is associated with symptoms of ocular discomfort*".

Definition

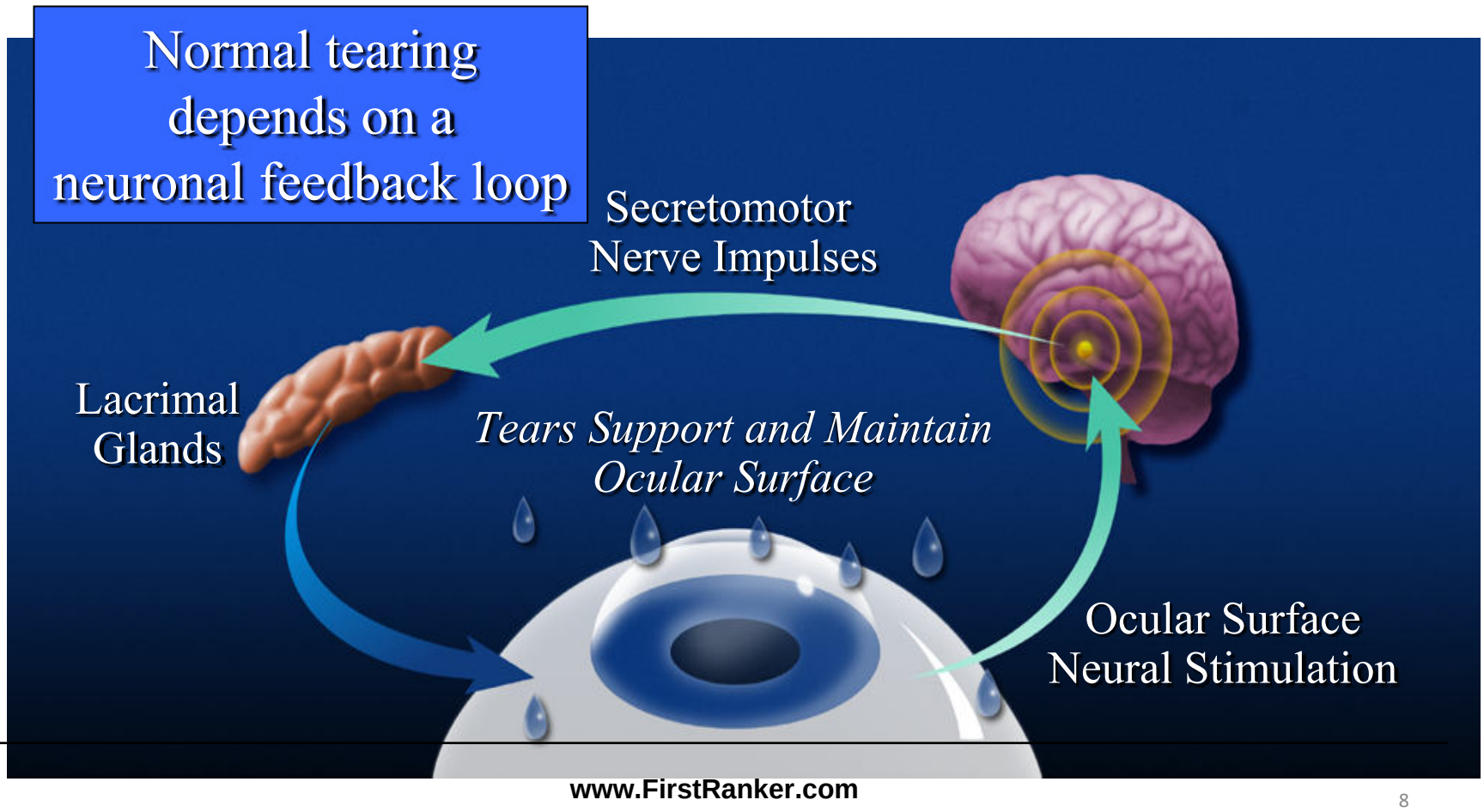
- In 2007 the International Dry Eye Workshop defined it as

" *a multifactorial disease of the tears and ocular surface that results in symptoms of discomfort, visual disturbance, and tear film instability with potential damage to the ocular surface. It is accompanied by increased osmolarity of the tear film and inflammation of the ocular surface*."

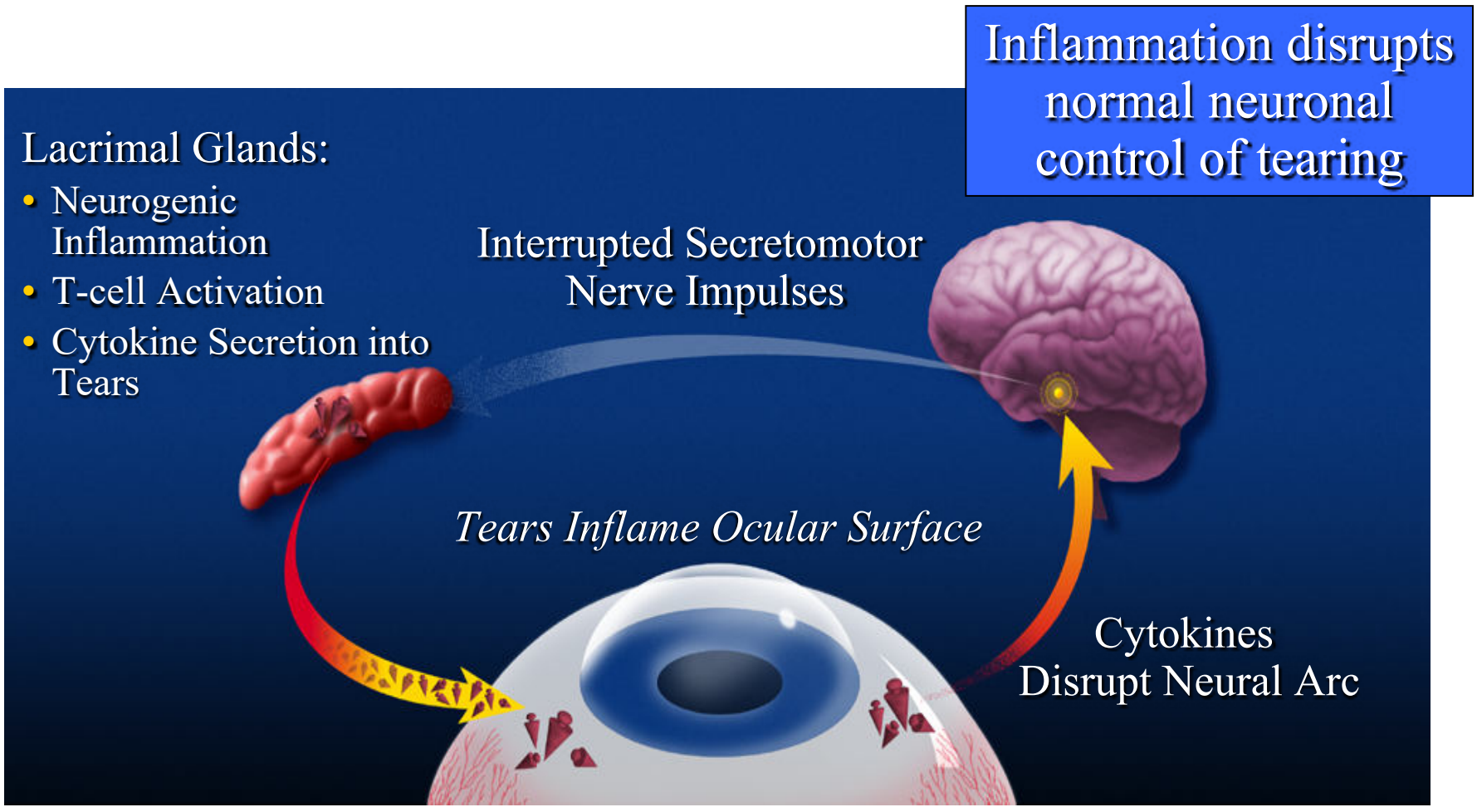
Dry Eye is more than a red eye.

Dry Eye
Affects Quality of Life

The Healthy Eye



Dry Eye Disease: An Immune-Mediated Inflammatory Disorder



Multiple Factors in Dry Eye

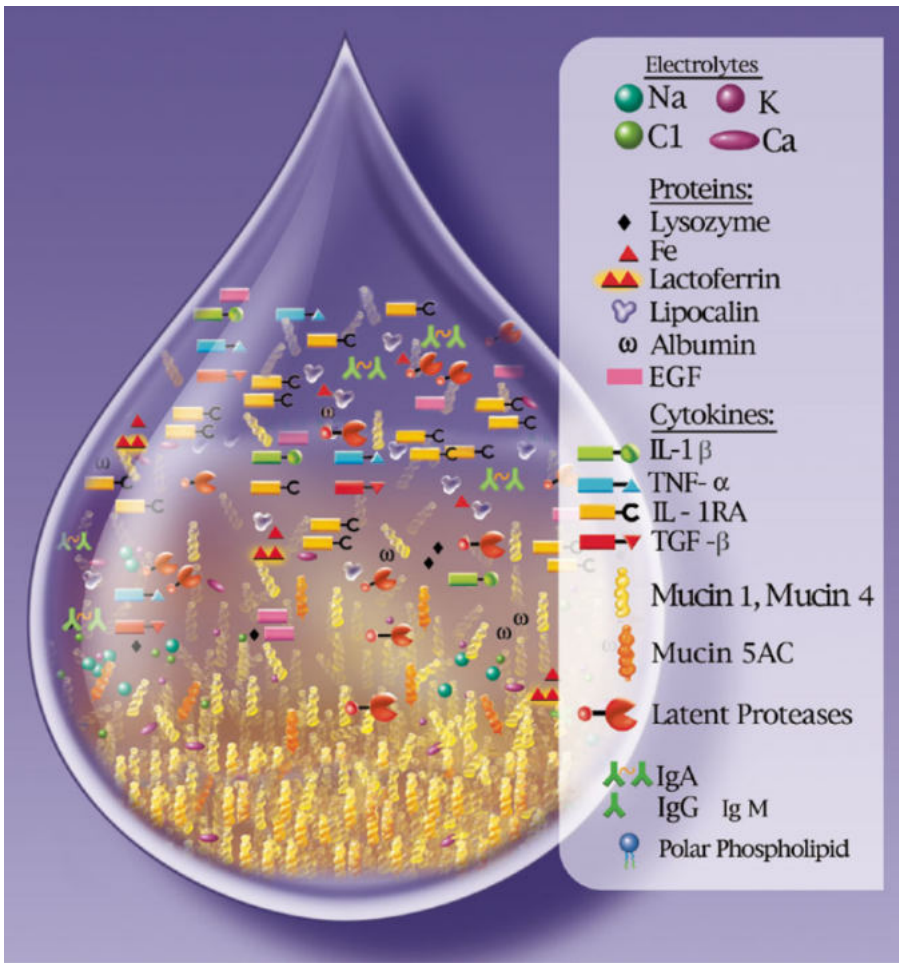
- Transient discomfort
- May be stimulated by environmental conditions
- Inflammation and ocular surface damage
- Altered tear film composition

Role of Inflammation in Chronic Dry Eye

- Inflammation may be present but not clinically apparent
- Cycle of inflammation and dysfunction
- If untreated, inflammation can damage lacrimal gland and ocular surface
- Consequences:
  - Lower tear production
  - Altered corneal barrier function

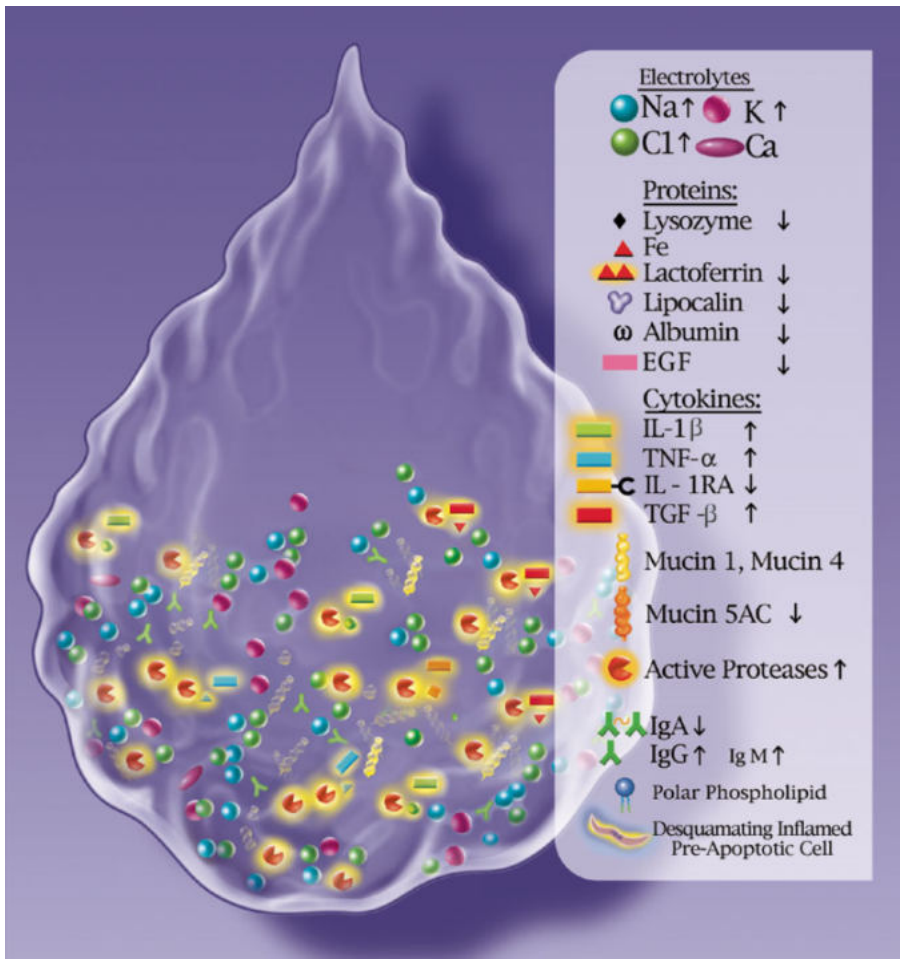
Healthy Tears

- A complex mixture of proteins, mucin, and electrolytes
  - Antimicrobial proteins: Lysozyme, lactoferrin
  - Growth factors & suppressors of inflammation: EGF, IL-1RA
  - Soluble mucin secreted by goblet cells for viscosity
  - Electrolytes for proper osmolarity



Tears in Chronic Dry Eye

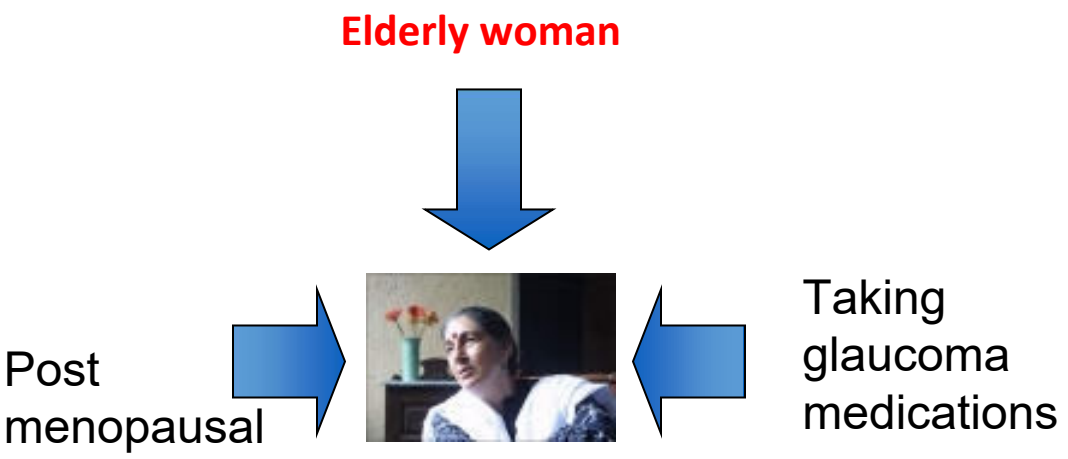
- Decrease in many proteins
- Decreased growth factor concentrations
- Altered cytokine balance promotes inflammation
- Soluble mucin 5AC greatly decreased
  - Due to goblet cell loss
  - Impacts viscosity of tear film
- Proteases activated
- Increased electrolytes



Who Is Likely to Have Dry Eye?

How Do We Diagnose It?

Dry Eye: Multifactorial nature



Patient Types with High Incidence of Dry Eye Disease

- Women aged 50 or older
- Women using postmenopausal hormone replacement therapy
- Those with ocular co-morbidities –

  xerophthalmia, cicatrical pemphigoid,

  atopic keratoconjunctivitis, ocular rosacea

- Contact lens wearers

- Smokers

Dry Eye Disease: Predisposing Factors

- Ageing
- Menopause - Decreased Androgens
- Allergy Response
- Environmental Stresses
  - Contact Lens Wear
  - Wind
  - Air Pollution
  - Low Humidity: Heating/AC
  - Lack of Sleep
  - Use of Computer Terminals
- Ocular Surgery (LASIK, Corneal Transplant)
- Medications

Medications That May Contribute to Dry Eye Disease

- Systemic
  - Anti-hypertensives
  - Anti-androgens
  - Anti-cholinergics
  - Antidepressants
  - Cardiac Anti-arrhythmic Drugs
  - Parkinson's Disease Agents
  - Antihistamines

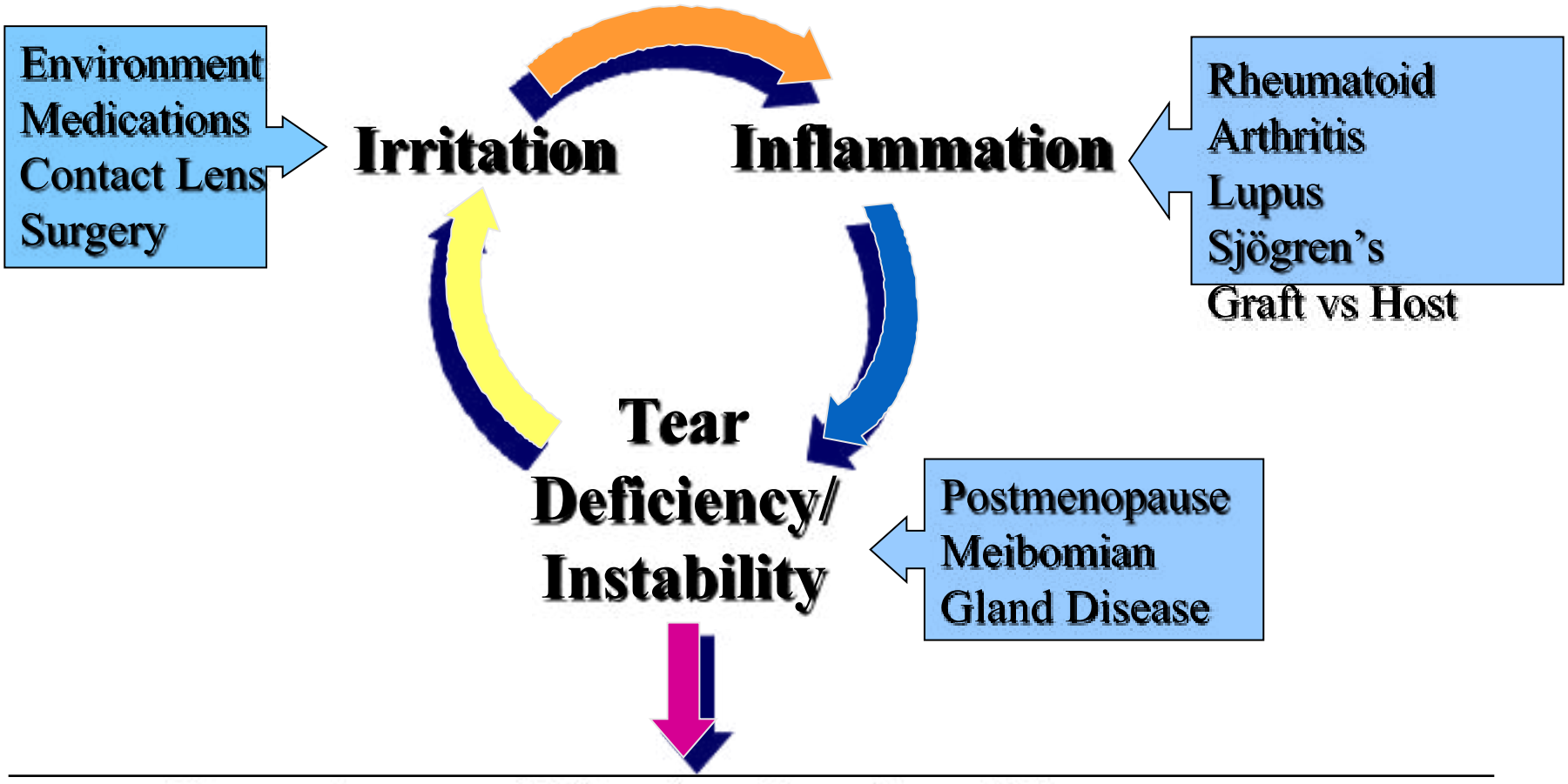
Topical

- Preservatives in Tears

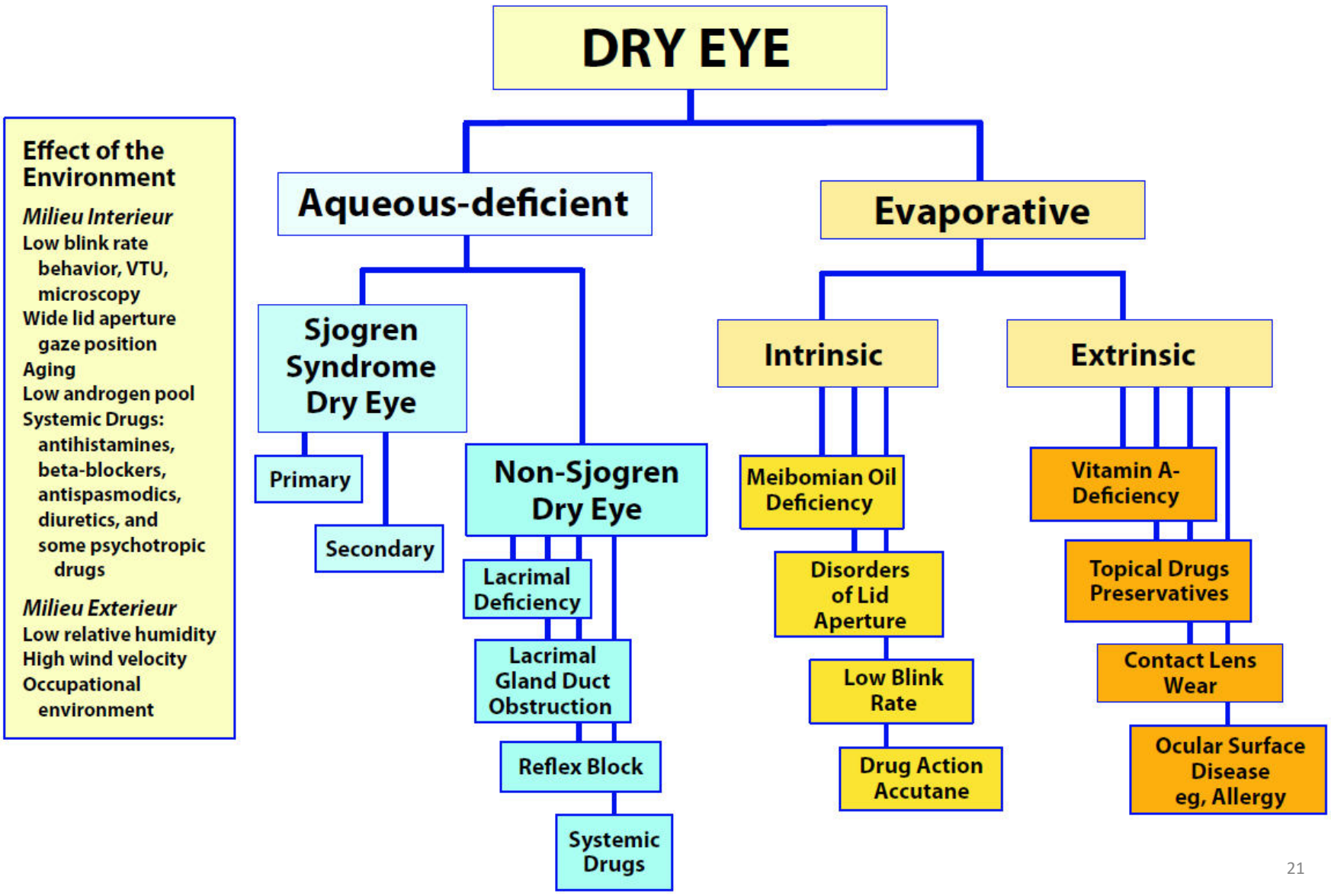
Dry Eye Disease: Autoimmune Triggers

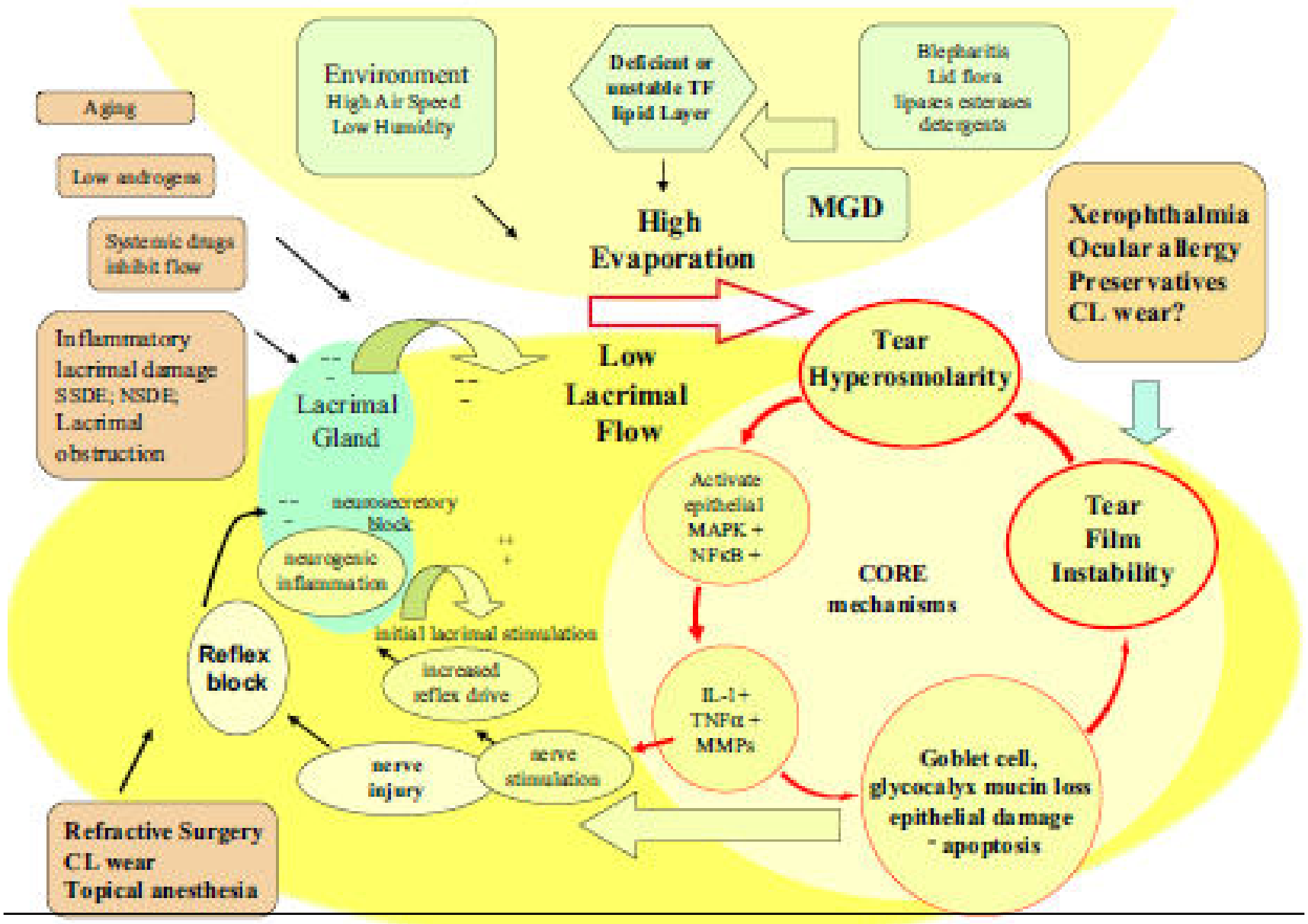
- Systemic Autoimmunity
  - Rheumatoid Arthritis
  - Lupus
  - Sjögren's Syndrome
  - Graft vs. Host Disease
- All can result in immune-mediated inflammation in the eye.
- Inflammatory mediators secreted into tears.
  - Promote inflammation of ocular surface.

Current Triggers of Dry Eye Disease



DEWS DEFINITION AND CLASSIFICATION





Dry Eye Disease Symptoms

- Discomfort
- Dryness
- Burning, Stinging
- Foreign-Body Sensation
- Gritty Feeling, Stickiness
- Blurry Vision
- Photophobia, Itching,
- Redness

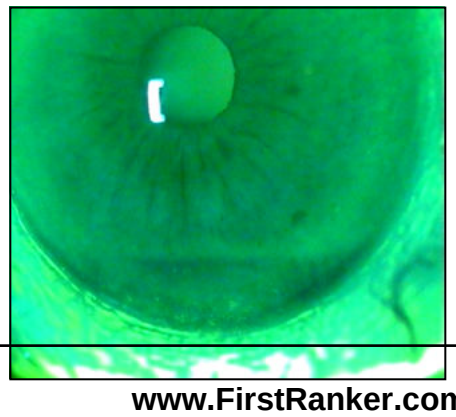
Note: Symptoms seldom correlate with clinical signs

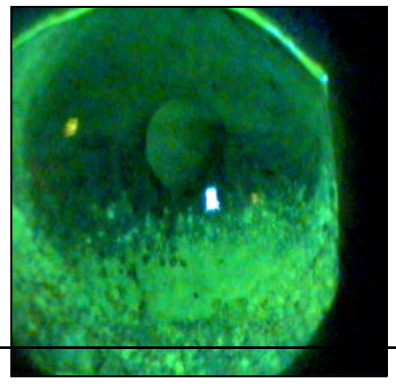
Clinical Presentation Can Vary in Severity

Mild → Severe

Slitlamp

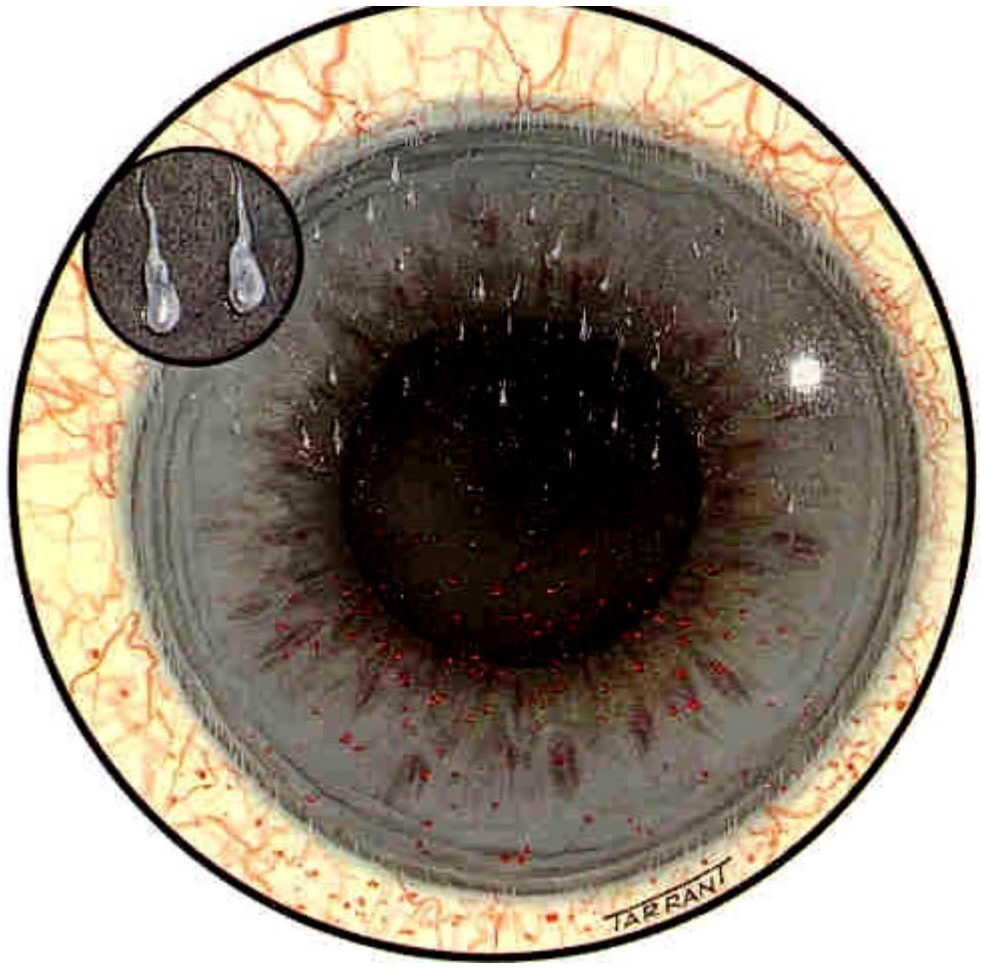
Fluorescein Dye Stain





Slit lamp examination

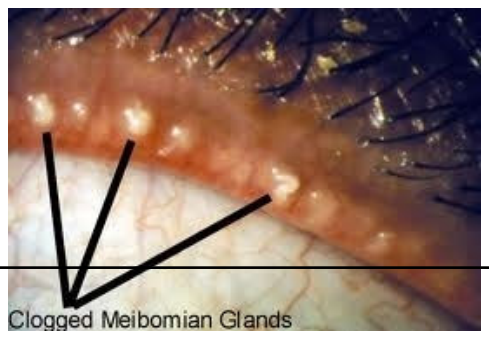
- Increased debris/mucin strands in tear film
- Inspection of tear meniscus at lid margin.
  - Normal thickness – 1mm, convex.
  - < 0.5mm – tear deficiency.
  - In severe cases – Marginal tear meniscus is concave, small & absent.



Filaments (comma shaped) over corneal surface which move on blinking

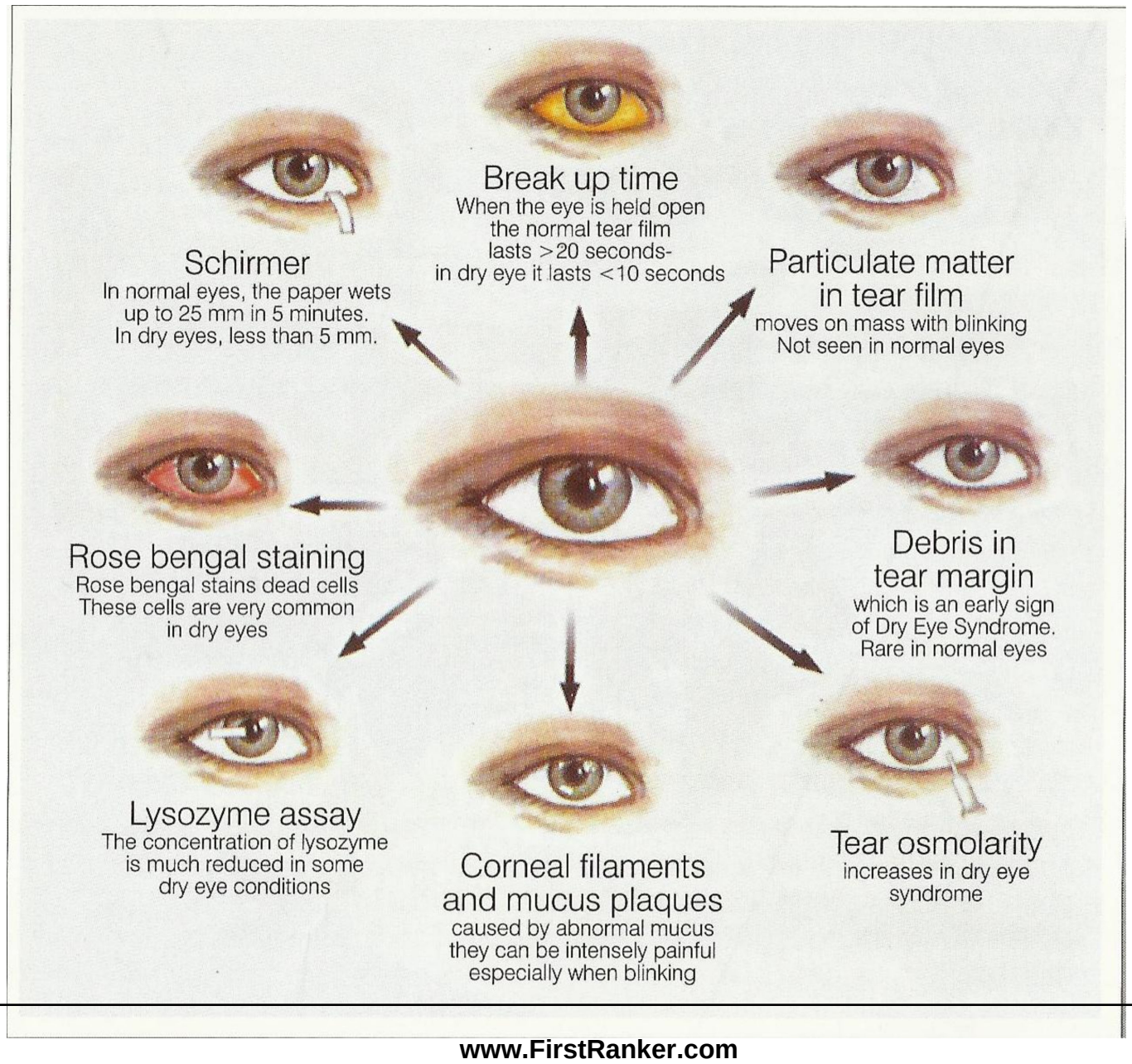
Mucous plaques – semi-transparent, white to grey, slightly elevated lesions
Stain with rose bengal.

- Bulbar conjunctival vessels may be dilated → Red Eye
- Corneal surface – irregularity/ dry areas.
- Blinking – incomplete/infrequent.
- Meibomian gland dysfunction/ blepharitis.



Diagnostic Tests

- Appropriate choice of test helps the clinician to arrive at an accurate diagnosis as well as for individualization of therapy.

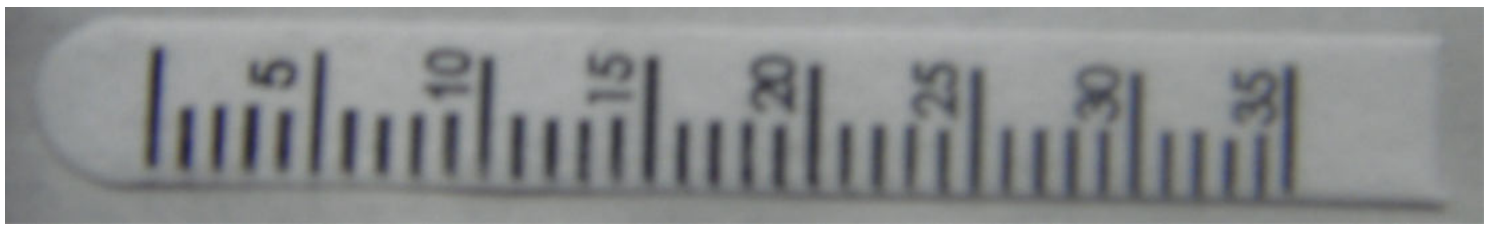


1. Basic Secretion Test

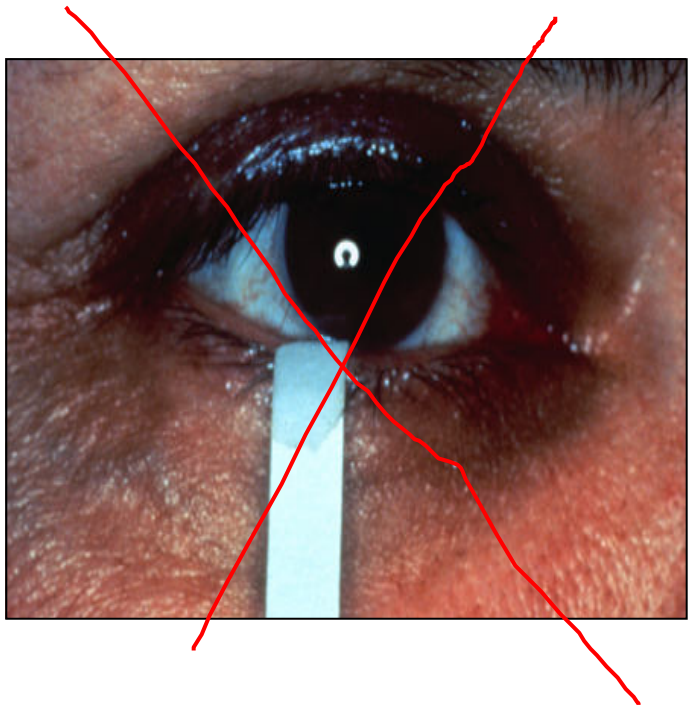
- Purpose – to measure basal secretion by eliminating reflex tearing.
- < 5mm → hyposecretion.

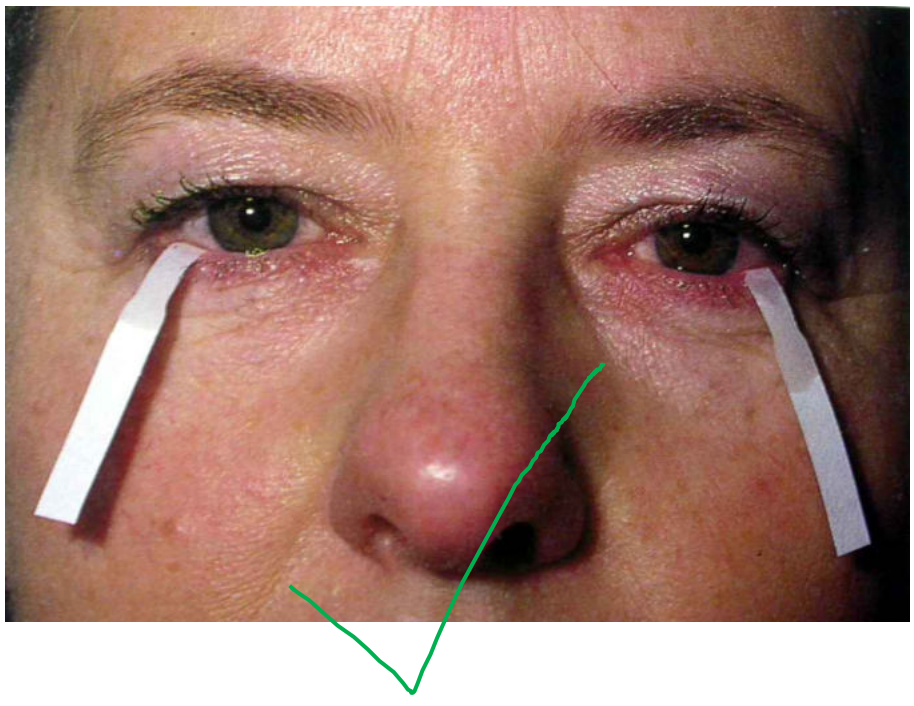
2. Schirmer's Test I

- Purpose – measurement of the total (reflex + basal) tear secretion.
- Eyes should not be manipulated before starting this test.

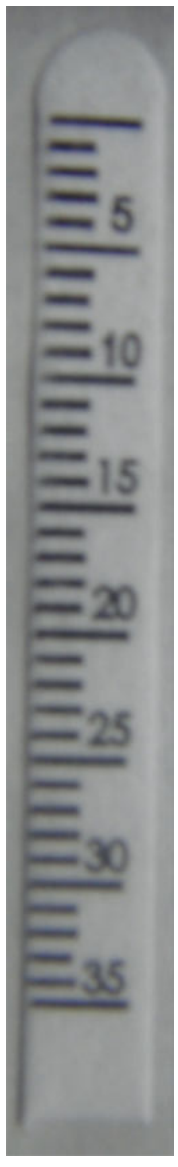


Schirmer Test





- Normal wetting 10-15 mm
- Dry Eye
  - Mild 9-14 mm
  - Moderate 4-8 mm
  - Severe < 4 mm



Schirmer Test II

- Purpose – to ascertain reflex secretion.
- Measured after 2 minutes.
- After Strips are placed in eye→ un-anaeasthetized nasal mucosa is irritated.
- Less than 15 mm→ failure of reflex secretion.

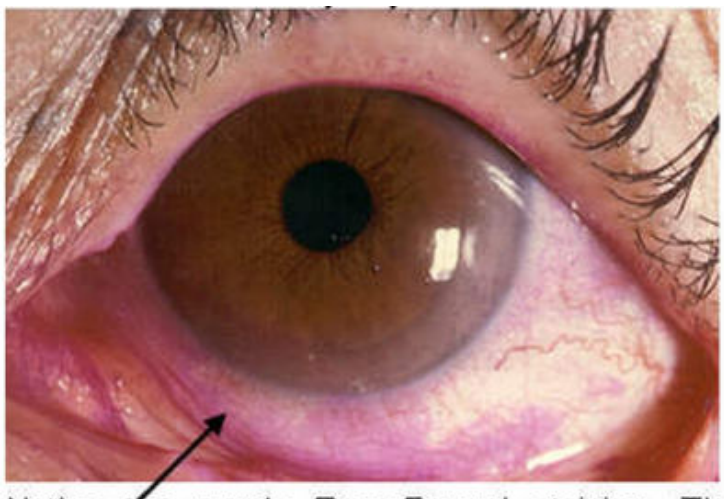
Rose Bengal staining

- Purpose - to ascertain indirectly, the presence of reduced tear volume by the detection of damaged epithelial cells.

- Useful in early stages of conjunctivitis sicca and keratoconjunctivitis sicca syndrome.

Rose Bengal Staining

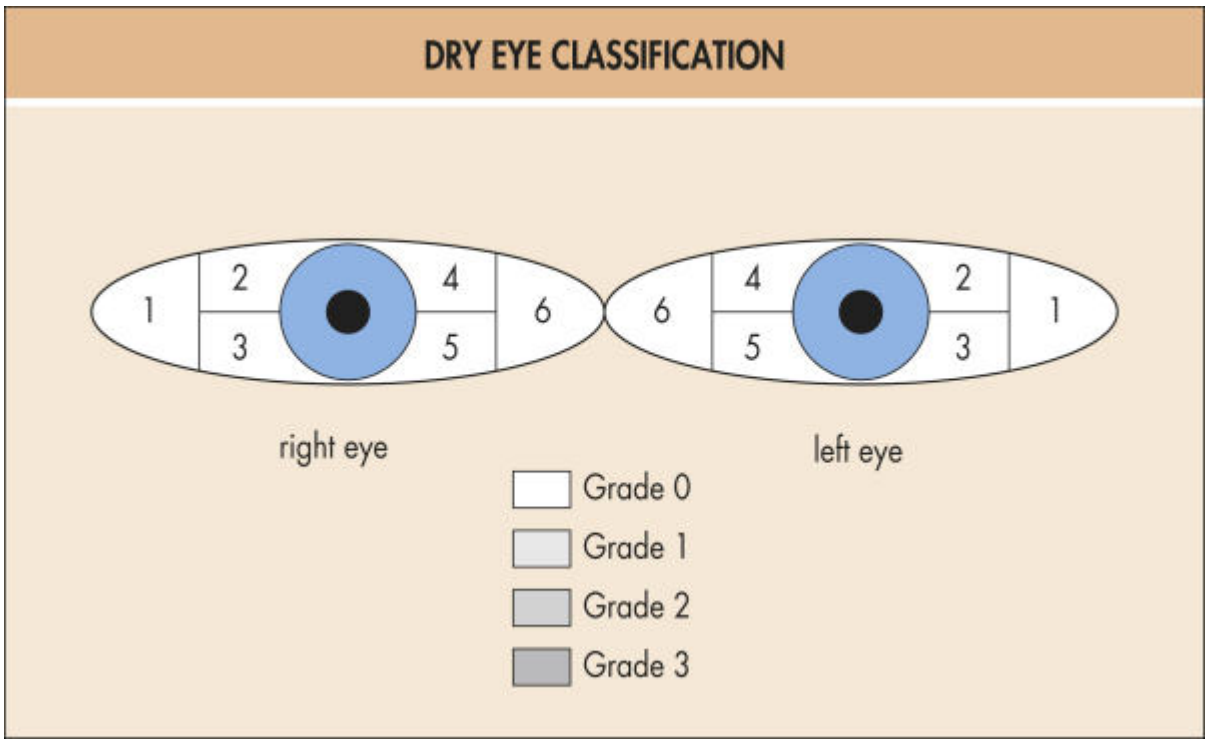
- Positive test – show triangular stipple staining of nasal and temporal bulbar conjunctiva in the interpalpebral area & possible punctate staining of the cornea (esp. lower 2/3rd).



Notice the purple Rose-Bengal staining. The white of the eye normally should not take up any stain. Even though there is no deficiency of tear production, the eye is dry because the tear film is very unstable and breaks easily. There may be increased evaporation of tears as well. The symptoms are of constant eye irritation.

Rose Bengal Staining

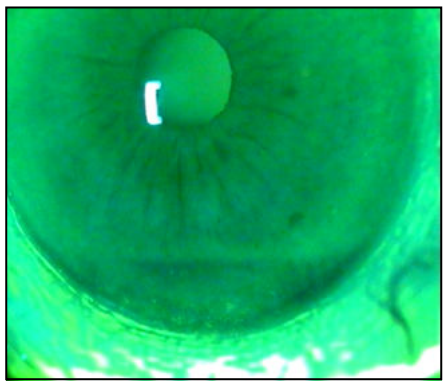
- False positive –
  - Chronic conjunctivitis
  - Acute chemical conjunctivitis, secondary to hair spray use and drugs such as tetracaine & cocaine
  - Exposure keratitis
  - Superficial punctate keratitis, secondary to toxic or idiopathic phenomena.
  - Foreign bodies in conjunctiva.

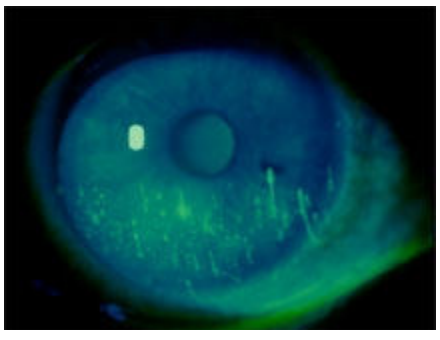


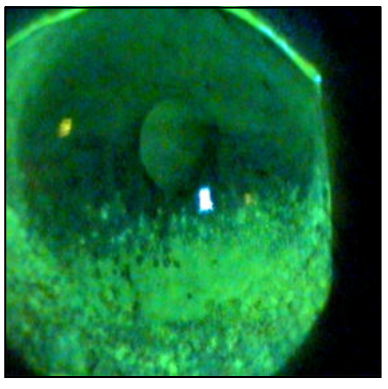
Modified van Bijsterveld conjunctival rose bengal grading map.

The density of rose bengal staining is recorded on a scale of 0-3 for each of 6 areas of the conjunctiva, and then summed for each eye.

Fluoroscein Dye Test

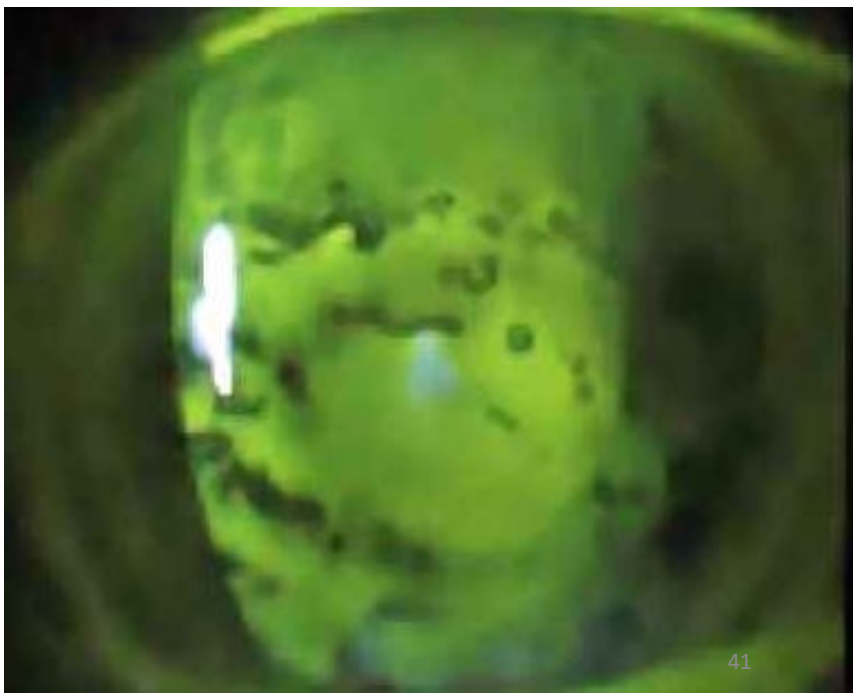


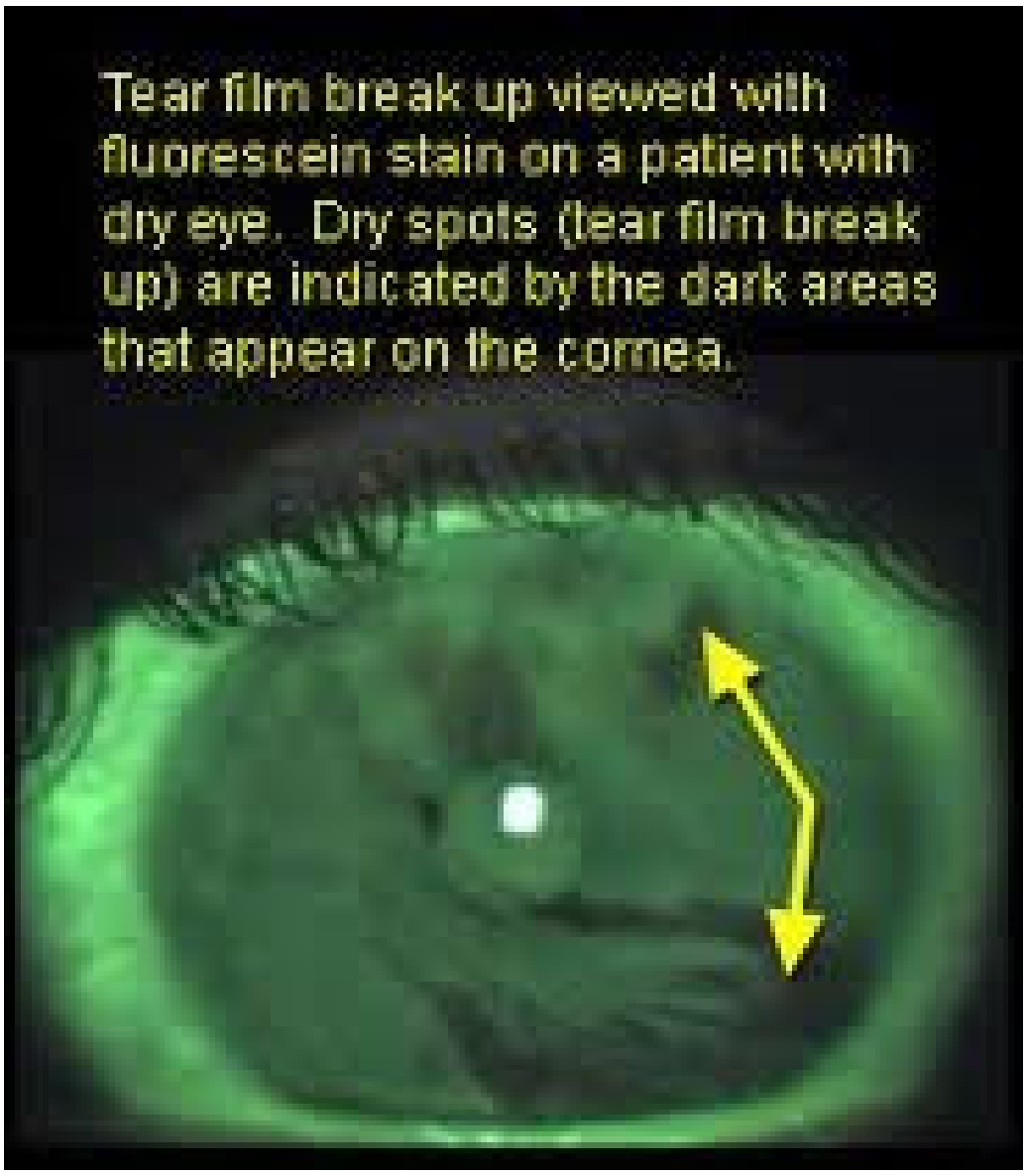




Tear film Break-up time (BUT)

- Time of appearance of first dry spot from the last blink.
- Tests for stability of tear film.



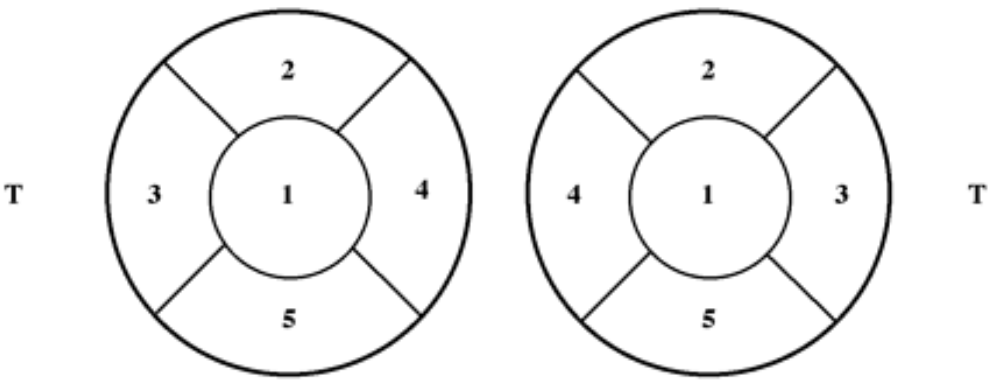


Tear film Break-up time (BUT)

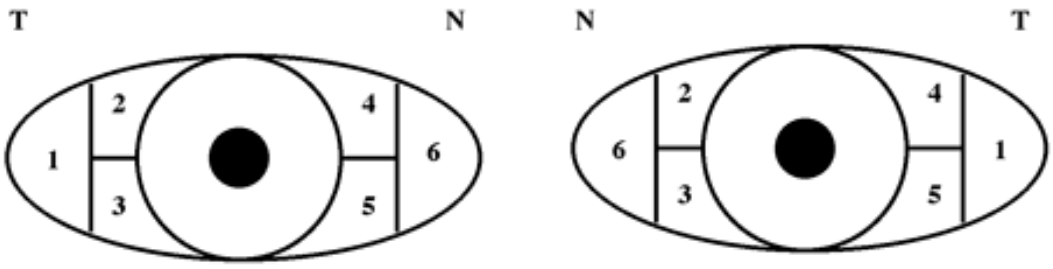
- Wetting time > 20 s → Normal Tear film stability.
- BUT Averages b/w 25-30 s in Normal individuals.
- Women < Men
- Less in elderly
- BUT < 10 s → significant tear film instability.

NEI Workshop grading

Corneal Diagram:



Conjunctival Diagrams



Efron Scale

- Grade 0 = no staining
- Grade 1 = trace staining
- Grade 2 = mild staining
- Grade 3 = moderate staining
- Grade 4 = severe staining

Other tests

- Practical Double Vital Staining for Ocular Examination
- Corneal Residence Time Test or Tear Clearance Rate (TCR)
- Tear Function Index
- Tear Film Osmolarity Test
- Tear Lactoferrin Test
- Tear Lysozyme Test
- Impression Cytology
- Biopsy of Labial Accessory Salivary Glands
- Ocular Ferning Test

Tear Film Osmolarity Test

- Tear Samples are collected with hand-drawn micropippete from inferior marginal tear strip, without disturbing the ocular surface.
- Tear osmolarity is determined by a freezing point depression osmometer.
- Normal – 295 to 309 mOsm/litre
- Elevated in Dry Eyes.

Impression Cytology

- To determine the goblet cell density of bulbar & palpebral conjunctiva.
- A strip of filter paper is gently pressed against the bulbar & palpebral conjunctiva with a glass end.
- Staining with Schiff's agent & counter staining with haemotoxylin → graded with microscope.
- Dry Eyes → ↓ goblet cell counts.

DEWS Dry eye severity grading scheme

Dry Eye Severity Level	1	2	3	4
Discomfort, severity & frequency	Mild and/or episodic; occurs under environmental stress	Moderate episodic or chronic, stress or no stress	Severe frequent or constant without stress	Severe and/or disabling and constant
Visual symptoms	None or episodic mild fatigue	Annoying and/or activity-limiting episodic	Annoying, chronic and/or constant, limiting activity	Constant and/or possibly disabling
Conjunctival injection	None to mild	None to mild	+/-	+/++
Conjunctival staining	None to mild	Variable	Moderate to marked	Marked
Corneal staining severity/location	None to mild	Variable	Marked central	Severe punctuate erosions

Dry Eye Severity Level	1	2	3	4
Corneal/tear signs	None to mild	Mild debris, ↓ meniscus	Filamentary keratitis, mucus clumping, increased tear debris	Filamentary keratitis, mucus clumping, increased tear debris, ulceration
Lid/meibomian glands	MGD variably present	MGD variably present	Frequent	Trichiasis, keratinization, symblepharon
TBUT (sec)	Variable	≤ 10	≤ 5	Immediate
Schirmer score (mm/5 min)	Variable	≤ 10	≤ 5	≤ 2

Left Untreated, Chronic Dry Eye May Become a Progressive Disorder

- Patients suffering from dry eye disease may move between severity levels and can become worse, if untreated.
  - Disease management options can be adjusted for individual patients depending on disease severity

Management

Aims of Treatment

- Relieve discomfort
- Provide smooth optical surface
- Prevent structural ocular surface damage

Modalities of treatment

- Preservation of existing tears
- Reduction of tear drainage
- Tear substitutes
- Treat any other associated eye disease which predisposes to dry eye
- Other options

Preservation of existing tears

- Environmental modifications such as humidification, avoidance of wind/dusty or smoky environment, avoid central heating
- Lifestyle/workplace modifications
  - taking regular breaks from reading or computer use
  - lowering computer monitor below eye level
  - increasing blink/fast blinking exercise
  - discontinuing medications that exacerbate DED
- A small lateral tarsorrhaphy – useful in incomplete lid closure.

Reduction of tear drainage

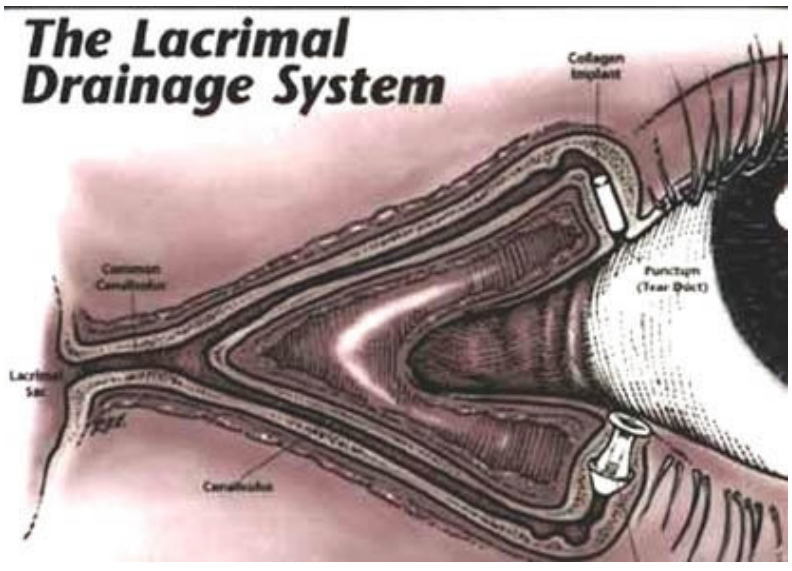
Done by punctual occlusion

- Preserves natural tears & prolongs effect of artificial tears
- Greatest value in severe KCS who have not responded to frequent use of topical treatment.
- May be –
  - Short term occlusion
  - Permanent occlusion

Temporary occlusion

- Collagen plugs are used.
- Dissolve in 1-2 weeks time.
- Initially all four puncta are occluded
- If epiphora occurs, then upper two plugs removed

  If patient is asymptomatic, then lower puncta are permanently occluded

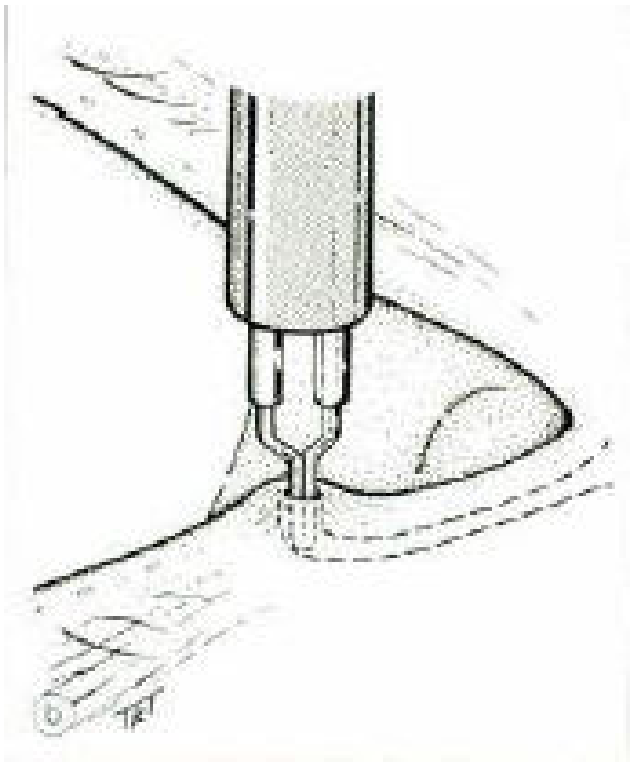


Reversible occlusion

- Reversible prolonged occlusion with silicone/ long acting collagen plugs (that dissolve in 2-6 wks).
- Problems –
  - Extrusion
  - Granuloma formation
  - Distal migration.

Permanent occlusion

- Done in severe KCS & repeated Schirmer < 2mm
- Should not be done in –
  - Patients who develop epiphora following temporary occlusion of lower puncta
  - Young patients as their tear production tends to fluctuate
- Done by cautery



Tear substitutes

- Artificial Tear Drops used.
- Stabilize & thicken pre-corneal tear film .
- Prolongs tear film B.U.T.
- Keeps ocular surface wet & lubricated .
- Helps to repair ocular surface damage
- Keeps ocular surface smooth

Tear substitutes

- **Drops** - Frequent instillation is required
  Preservative free drops are better

- **Gels** – Consists of carbomers
  Less frequent instillation required

- **Ointments** – Contains petroleum mineral oil & used at bedtime

Mucolytic agents – 5 % acetylcysteine drops QID to disperse corneal filaments & mucous plaques.

Eye Drops

- Cellulose derivatives –
  - Hydroxypropyl methylcellulose
  - Carboxymethylcellulose [more useful in lipid or mucous deficiency]
  - Appropriate for mild cases.
- Polyvinyl alcohol – Better in aqueous deficiency
  - Dose
    - ✓ QID in mild cases
    - ✓ ½ hrly – 2 hrly in severe cases
- Povidone
- Sodium chloride
- Hypromellose
- Sodium hyaluronate
- Polyethylene and propylene glycol

Treatment of associated diseases

- Meibomian gland disease/ Blepharitis –
  - Lid hygiene – warm compresses, lid massage
  - Lid scrubs
  - Systemic Doxycycline/ Azithromycin/ Roxitromycin
  - Correction of eyelid abnormalities – blepharoptosis, lagophthalmos

Other options

- Topical cyclosporine [0.05%, 0.1%]
  - Reduces cell-mediated inflammation of lacrimal tissue → increase in goblet cells, reversal of squamous metaplasia of conjunctiva.
- Oral cholinergic agents (M3) like pilocarpine , cevimeline
  - Effective in xerostomia & about 40% of KCS patients also obtain relief
- Botulinum toxin injection to orbicularis muscle – controls blepharospasm in severe dry eye.
- Sub-mandibular gland transplantation – for extreme dry eye.

The DEWS treatment recommendations were based on the modified severity grading (based on severity level)

Level 1:

Education and counselling
Environmental management
Elimination of offending systemic medications
Preserved tear substitutes, allergy eye drops

Level 2:

If Level 1 treatments are inadequate, add:

Unpreserved tears, gels, ointments
Steroids
Cyclosporine A
Secretagogues
Nutritional supplements

Level 3:

If Level 2 treatments are inadequate, add:

Tetracyclines

Autologous serum tears

Punctal plugs (after control of inflammation)

Level 4:

If Level 3 treatments are inadequate, add:

Topical vitamin A

Contact lenses

Acetylcysteine

Moisture goggles

Surgery-Amniotic Membrane Transplanatation

Limbal stem cell graft

Keratoplasty

Thank You