Dry eye disease is a chronic inflammatory condition of the eye in which the precorneal film gets altered in function due to the dysfunction of tear volume or tear quality alone or both leading to a complex symptomatology.

Dry eye may be sight-threatening

**Classification -- Murube & Rivas classification (2003)**

Grade-0 = Normal
Grade-1 = Occasional Symptoms No Signs
Grade-2 = More Often Symptoms No Signs
Grade-3 = Symptoms Present In Daily Life And Signs Also Present
Grade-4 = Symptoms Present Always. Signs Present
Grade-5 = Symptoms And Signs In Form Of Scarring, Vascularization Of Cornea

Dry Eye: Main Causes

- Tear deficient dry eye
- Keratoconjunctivitis sicca (KCS)

Prevalence of dry eye increases significantly with age and is more common in women.
**Sjogren's:** Autoimmune disorder with a triad of dry mouth, dry eye and arthritis

**Non-Sjogren's:**

**Ageing:** Gradual deterioration of lacrimal gland tissue occurs with ageing

**Menopause:** At the time of menopause, levels of androgens drop down

**Neurotrophic keratitis:** Corneal sensitivity decreases after LASIK, PRK, contact lens wear and diabetes

**Medicamentosa:** Anti histamines, anti-depressants, beta blockers

**Cicatricial Diseases:** Trachoma, chemical burns, Stevens Johnson syndrome


**EVAPORATIVE DRY DISEASE**

Meibomian gland disease: Most prevalent (65%). Obstruction of meibomian gland

Lid surface anomalies: Lid closure affected, blinking affected

Ocular surface toxicity: Long term use of topical antiglaucoma medications, preservatives like BAK

Contact lens related

**Allergy**

LASIK induced dry eye

Creation of partial corneal flap

Certain amount of nerve damage occurs

Decreased corneal sensation

Reduction of tears

**Contact Lens Wear**

20-30% of contact lens wearers have dry eye symptoms.

The presence of contact lens, hard or soft, represents a stress to the tear film and can lead to contact lens-induced dry eye.

Decreased corneal sensation

Reduced reflex tearing

Increased evaporation

(abs of replacement of disrupted tear film)

**Hypertonic tear film**

(increased osmolarity, i.e increase in solutes)

Hypertonic tear film indicating dry eye causes symptoms of discomfort during lens wear.

Extensions of interblink period due to intense concentration due to close work and computer work concentration leads to drying of ocular surface.

Normal blink rate : 15 times/min

Working on computer: 5 times/min

**Chronic Allergy**

Dry eye is commonly associated with chronic allergic conjunctivitis.

An allergic history has been reported by 36% of dry eye patients.

Chronic allergy results in loss of goblet cells, destabilization of the tear film & damage to ocular surface.

VKC is associated with 38% incidence of dry eye.

**Symptoms**

Irritation

Redness

Burning/Stinging

Itchy eyes

Sandy-gritty feeling (foreign body sensation)

Blurred vision

Tearing

Contact lens intolerance

Increased frequency of blinking

Mucus discharge

Photophobia (less frequent symptom)

Symptoms worsen in windy or air-conditioned environments.

As day progresses.

After prolonged reading, working on computers

**Clinical signs**

Chronic papillary conjunctivitis

Chronic meibomitis - toothpaste sign

Blepharitis

Debris in tear film

Presence of lipofuscin (red parallel conjunctival fold)

Intepalpebral hyperemia

Tear marginal meniscus < 0.5 mm

Meibomian gland health

Gland orifice metaplasia

Meibomian gland expression test

trans illumination of inferior tarsus

**Meibomian Gland Expression Test:**

Grade-0 Expression Of Five Glands

Grade-1 Four Glands Expressed
Grade-2: Three Glands Expressed
Grade-3: Two Glands Expressed
Grade-4: No Glands Expressed

Pathophysiology

Tears are a complex solution composed of water, enzymes, proteins, immunoglobulins, lipids, various metabolites, exfoliated epithelial and polymorphonuclear cells

Lacrimal apparatus

Tears: Functions
- Lubricate the ocular surface.
- Nourish the ocular surface.
- Forms a smooth, even layer over ocular surface.
- Provides an antibacterial system for ocular surface.
- Serves as a vehicle for the entry of PMNs in case of injury.
- Dilutes and washes away toxic irritants.

Production and turnover of tears is essential to maintain health of the ocular surface.

Tears: Physical Properties
- Rate of secretion: 1.2 ml/min (Basal).
- Turnover rate: 12-16%/min.
- Osmolarity: 310-334 mOsm/k.
- pH: 7.5 ± 0.16.

Tear Film: Anatomy & Physiology

- Trilaminar structure
  - Consists of:
    - Thin anterior lipid layer (0.1 mm)
    - Intermediate aqueous layer (7 mm)
    - Innermost mucous layer (0.02-0.04 mm)

Lipid Layer
- Oily covering composed of waxy and cholesterol esters.
- Secreted predominantly by the meibomian glands.
- Function: Inhibit evaporation of underlying aqueous layer.

Aqueous Layer
- Sandwiched between lipid and mucin layer.
- Comprises vast majority of tear film thickness.
- Secreted by the lacrimal glands.
- Function:
  - Lubricate cornea and conjunctiva.
  - Cleanses by flushing debris from ocular surface.
  - Important for immunity and nutrition of ocular surface.

Mucin Layer
- Innermost component of tear film.
- Secreted by the goblet cells of conjunctiva.
- Function:
  - To help aqueous layer adhere to corneal surface.
  - Help proper spreading of tear film.

DIAGNOSTIC TESTS

Schirmer's test I
- If Wetting <3mm=Severe Dry Eye.
- If Wetting 3-5 mm=Moderate Dry Eye.

Schirmer's test II
- Rose bengal/staining/lissamine green staining
- Fluorescein stain test

SCHIRMER'S TEST I

If Wetting <3mm=Severe Dry Eye
If Wetting 3-5 mm=Moderate Dry Eye
If wetting 5-10mm = Moderate Dry Eye
If wetting is 10mm = Mild Dry Eye
If wetting >10mm = Normal Eye

**SCHIRMER’S TEST II**

If wetting <10mm -- irritate the nasal mucosa with cotton bud, note add. wetting
If no wetting or <1mm -> Sjogren's syndrome
If wetting increases by 1mm -- Non-Sjogren’s syndrome

**Rose Bengal staining**

Rose Bengal solution 1% placed into the conjunctival sac.

After a wait of 2 mins, degree of rose bengal staining on bulbar conjunctiva and cornea is quantitated by microscopic exam.

Stains devitalized cells.

Also stains mucous strands (very often present in KCS)

**FLUORESCEIN STAIN TEST**

--> No staining = Grade -0
--> 1/3 = Grade -1
--> 2/3 = Grade -2
--> 3/3 = Grade -3

**TFRUT**:

Normal >10sec
Grade 4 <3sec

**Slit lamp fluorophotometry**:

-->GRADE-0: No superficial punctum corneal stain
-->GRADE-1: No severe SPK at center of cornea
-->GRADE-2: Mild SPK at center of cornea
-->GRADE-3: Severe SPK at center of cornea

**OCULAR PROTECTIVE INDEX (OPI)**:

OPI<1 = Patient at risk
OPI>1 = Not at risk
TEAR OSMOLARITY:
Normal=302Mos+_6.3/litre
Dry Eye=>350Mos/litre

CLOSED CHAMBER INFRARED THERMOMETRY:
Normal: TEMP INCREASED by 0.1 degree Celcius after opening the eye
Dry Eye: NO INCREASE IN TEMP after opening the eye

CLOSED CHAMBER HUMIDITY OF THE EYE:
Normal = < 1RH%
Dry eye = > 1RH%(1RH% TO 4RH%)
Features-> Most reliable, Quick, Non-invasive for dry eye

LAB DIAGNOSIS

IMPRESSION CYTOLOGY

CA 19-9 ELISA TEST
OCULAR FERNING TEST:
No Ferning:
Pemphigus
Stevenson Johnson syndrome
Non Dry Eye: Ferning is present in 91%

Dry Eye: Management

MEDICAL THERAPY
SUPPORTIVE THERAPY
THERAPY OF THE UNDERLYING CAUSE
SURGICAL THERAPY
TREATMENT OF DRY EYE IS NOT "ONE SIZE FITS ALL"

MEDICAL THERAPY

TEAR SUBSTITUTES
Tear substitutes benefits
Tear substitutes are the mainstay of therapy for dry eye.
Provide adequate relief
Increase humidity at the ocular surface and improve lubrication.
Smooth the ocular surface leading to improved vision.
Intra/post-operative use has shown to help restore ocular surface after refractive surgery.
Improve patients' quality of life.

What should an ideal tear substitute contain?
Polymer (ocular lubricant)
Electrolytes
Preservative

Polymers in tear substitutes
Carboxymethylcellulose (CMC)
Hydroxypropylmethylcellulose (HPMC)
Polyvinyl Alcohol (PVA)

Carboxymethylcellulose 0.5% : Highlights
Carboxymethylcellulose provides better protection, lubrication and clinical efficacy compared to other polymers.
Improves the health of conjunctival and corneal cells in patients with KCS.
Plays a role in the reversal of squamous metaplasia in patients with KCS.
Superior to HPMC in alleviating symptoms of KCS.
Provides immediate relief and lasting protection against dryness and irritation.
Appropriate to use when conventional tear substitutes are inadequate.
Comfortable upon instillation.
Safe to use as often as needed.
Appropriate to use for post-LASIK ocular dryness.

Electrolytes
Electrolytes in "artificial tears" mimic human tears and renew dry eyes.
Provide an environment for the ocular surface conducive to re-establishment of normal corneal epithelial barrier.
Electrolytes are crucial in maintaining conjunctival goblet cells.

Preservative
CHEMICAL-BAK, Chlorbutol, Phenyl Mercuric Nitrite, etc.
OXIDATIVE-Stabilized Oxy-chloro-complex, Sodium Perborate
NON-TOXIC TO EPITHELIUM

Dry eye patients: Adverse Effects of preserved medications

- More susceptible to toxic effects of topical medications.
- Inhibited tear clearance resulting in prolonged residence time of preservatives (potential toxins) on the ocular surface.
- Prolonged exposure to preservatives leads to inflammation which leads to chronic irritation and can worsen dry eye.
- Hence artificial tears must be free of toxic preservatives, particularly if dosing at greater than 4-6 times/day.

How about a preservative that keeps the eye drops preserved in the bottle but preservative free in the eye?

Preservative-free solutions thus established a new benchmark in artificial tear solution treatment.
SOC converts to natural components of tears in the eye:
- Sodium & Chloride ions
- Stabilized oxychloro-complex
- Oxygen + water

SLOW RELEASE ARTIFICIAL TEAR DEVICES (LACRISERTS)
- Advantage: Longer duration of action
- LUBRICATING OINTMENT
  - Non-medicated, semi-solid preparation, white petrolatum, liquid lanolin and mineral oil
  - Used only at bedtime
  - Retained longer than solution
- Local immunosuppressive agents
  - Cycloporin 0.05% to 0.1% two times a day
  - Autologous Serum
- Long-term treatment with sodium hyaluronate
- Castor oil eye drops for non-inflammatory obstructive gland dysfunction
- Supracutaneous administration of calcium ointment 10%
- Carboner gel 0.3%
- Androgens in dry eye
  - Secretagogues
  - Pilocarpine

SUPPORTIVE THERAPY
- Use of eye shields, glasses with side shields or swimmers goggles
- Contact Lens
- Vaportizer or humidifier

SURGICAL THERAPY
- Subcutaneous abdominal artificial tear pump. Reservoir for severe dry eyes
- Preservation of tears by occluding with punctal plugs
- Silicone punctal plugs
- Increase the contact lens wear
- Reduces dependency on tear drops
- Permanent intracameral silicone plug
- Occlusion of the punctum or with LASER or diathermy
- Autologous Limbal Transplantation
- Soluble Collagen Discs
- Amnion Membrane transplantation
- Auto conjunctiva (Punch patch technique)
- Rectal mucosa
- Lips mucosa
- Frontal sinus drainage
- Parotid duct transplantation
- Tarsorrhaphy in dry eye

Treating dry eye symptoms is important for short-term comfort and the long-term health of your cornea.