Understanding dry feeling eyes.
Diagnosis and Treatment

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Content – understanding dry feeling eyes

- Definition and incident
- Physiology of the eye
- Etiology and diagnosis
- Management
Dry Eye Syndrome (DES)

A team of international experts collectively defined dry eye syndrome as:

Dry eye is a multifactor 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.¹

Tear hyperosmolarity may reasonably be regarded as the signature feature that characterizes the condition of “ocular surface dryness”\(^1\)

Hyperosmolar levels in the tear film may transiently spike during tear instability, resulting in corneal inflammation and triggering sensory neurons\(^6\).
Population-based studies of dry eye\textsuperscript{1}

<table>
<thead>
<tr>
<th>Country</th>
<th>Study</th>
<th>N</th>
<th>Age</th>
<th>Prevalence*</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>Salisbury</td>
<td>2420</td>
<td>65+</td>
<td>14.6%</td>
</tr>
<tr>
<td>USA</td>
<td>Beaver Dam</td>
<td>3722</td>
<td>48+</td>
<td>14.4%</td>
</tr>
<tr>
<td>Australia</td>
<td>Blue Mountains</td>
<td>1075</td>
<td>50+</td>
<td>16.6%</td>
</tr>
<tr>
<td>Australia</td>
<td>Melbourne</td>
<td>926</td>
<td>40+</td>
<td>5.5%</td>
</tr>
<tr>
<td>Asia</td>
<td>Shihpai</td>
<td>2038</td>
<td>65+</td>
<td>33.7%</td>
</tr>
<tr>
<td>Asia</td>
<td>Sumatra</td>
<td>1058</td>
<td>21+</td>
<td>27.5%</td>
</tr>
</tbody>
</table>

*Different definitions of dry eye were used in each study.*
The tear film has 2 layers

- Lipid layer
- Aqueous/mucin gel layer
The Lacrimal Apparatus

Function: To optimise visual clarity

- Produces tears
- Produces tear film components
- Drains away tears
The Lacrimal Apparatus

Lacrimal Apparatus

- Principle and accessory (Kraus and Wolfring) lacrimal glands: produce tear fluid
- Goblet cells: secrete mucins
- Meibomian glands: secrete lipids
- Glands of Zeiss and Moll: secrete lipids
The 7 Functions of Tear Film

1) Maintains hydration of the eye
2) Lubricates the ocular surface
3) Nourishes the cornea
4) Cleanses the ocular surface
5) Defends against bacterial invasion
6) Buffers the pH of the ocular surface
7) Refracts light for visual clarity
Overview of Dry Eye Disease

Dry feeling eyes presents in 2 forms that can occur together:

- **Evaporative dry eye**: caused by increased evaporation of the tear film\(^1\)
- **Tear-deficient dry eye**: caused by changes in the tears themselves\(^1\)

Tear film instability can be caused by many things

Environmental factors  
Biological factors

# Causes of evaporative dry eye

<table>
<thead>
<tr>
<th>Environmental conditions</th>
<th>Low humidity, hot air, dust, wind, reduced blinking (from prolonged computer use, watching TV, reading)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eyelid inflammation</td>
<td>Blepharitis, ocular rosacea, meibomian gland dysfunction.</td>
</tr>
<tr>
<td>Lid surface anomalies</td>
<td>Ectropion, entropion</td>
</tr>
</tbody>
</table>

Photo courtesy of David W. Hansen, OD, FAAO
## Causes of Tear-Deficient Dry Eye

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sjögren’s syndrome</td>
<td>An autoimmune disease where the body attacks the tear glands</td>
</tr>
<tr>
<td>Non-Sjögren’s syndrome</td>
<td>A decrease in tear production caused biologically (e.g., thyroid disease, vitamin A deficiency, herpes eye infection, aging)</td>
</tr>
<tr>
<td>Medically induced</td>
<td>A decrease in tear production caused medically (e.g., anti-depressants, antihistamines, decongestants, diuretics, oral contraceptives, refractive surgery)</td>
</tr>
</tbody>
</table>

**Inflammation and Dry Eye Disease**

1. **Insult**
   - (irritation or hyperosmolarity)
   - Any trigger for dry eye disease can be a potential initial insult

2. **Activation of T-cells and more inflammatory substances**

3. **Inflammation**
   - When the body senses the insult, cytokines are released into the tear film. The inflammatory cascade begins with the good intention of protecting from the insult.

4. **Instability of tear film**
   - Long-term inflammation can also have detrimental effects on the tear film by affecting the neural signal to the lacrimal gland and decreasing tear production. This, in turn, is considered an insult and starts the cycle again.

5. **The inflammatory cascade**

6. **Environmental**
   - Behavioural
   - Physiological
   - Surgical

Slit Lamp Examination

Photo courtesy of Elena Garcia Rubio, DOO
Test of Tear Function

1. Tear break up time (TBUT)
   - Fluorescein is placed onto the ocular surface
   - The time it takes for dark areas to form is measured
   - Normal: > 10 sec (Caucasian); > 5 sec (Asian)
Test of Tear Function

2. Schirmer’s test
   - Apply a paper strip to the lower and measure the amount of wetting occurring over a specific time-period (e.g. 5 minutes)
   - Schirmer I (without anesthesia); Schirmer II (with anesthesia)
   - Dry Eye? < 10 mm in 5 mins (Schirmer II)
Test of Tear Function

3. Phenol Red Thread
   • A 70-mm thread impregnated with phenon red is inserted into the lowerlid for 15 seconds
   • Color changes from red to yellow when the thread absorbs the tears
   • Normal > 15 mm; dry eye < 9mm
Test of Tear Function

4. Tears meniscus
   - Can be seen resting on the lower lid
   - A height of 0.3 mm is considered normal
Other parameters?

- Transient increases in tear hyperosmolarity during tear instability caused the sensations noted by subjects.
Ocular Surface Disease Index

**Ocular Surface Disease Index (OSDI)**

Ask your patient the following 12 questions, and circle the number in the box that best represents each answer. Then, fill in boxes A, B, C, D, and E according to the instructions beside each.

**HAVE YOU EXPERIENCED ANY OF THE FOLLOWING DURING THE LAST WEEK?**

1. Eyes that are sensitive to light?
   - All of the time
   - Most of the time
   - Half of the time
   - Some of the time
   - None of the time
   - 4 3 2 1 0

2. Eyes that feel gritty?
   - All of the time
   - Most of the time
   - Half of the time
   - Some of the time
   - None of the time
   - 4 3 2 1 0

3. Painful or sore eyes?
   - All of the time
   - Most of the time
   - Half of the time
   - Some of the time
   - None of the time
   - 4 3 2 1 0

4. Blurred vision?
   - All of the time
   - Most of the time
   - Half of the time
   - Some of the time
   - None of the time
   - 4 3 2 1 0

5. Poor vision?
   - All of the time
   - Most of the time
   - Half of the time
   - Some of the time
   - None of the time
   - 4 3 2 1 0

Subtotal score for answers 1 to 5

**HAVE PROBLEMS WITH YOUR EYES LIMITED YOU IN PERFORMING ANY OF THE FOLLOWING DURING THE LAST WEEK?**

6. Reading?
   - All of the time
   - Most of the time
   - Half of the time
   - Some of the time
   - None of the time
   - 4 3 2 1 0

7. Driving at night?
   - All of the time
   - Most of the time
   - Half of the time
   - Some of the time
   - None of the time
   - 4 3 2 1 0

8. Working with a computer or bank machine (ATM)?
   - All of the time
   - Most of the time
   - Half of the time
   - Some of the time
   - None of the time
   - 4 3 2 1 0

9. Watching TV?
   - All of the time
   - Most of the time
   - Half of the time
   - Some of the time
   - None of the time
   - 4 3 2 1 0

Subtotal score for answers 6 to 9

**HAVE YOUR EYES FEEL UNCOMFORTABLE AT ANY OF THE FOLLOWING SITUATIONS DURING THE LAST WEEK?**

10. Windy conditions?
    - All of the time
    - Most of the time
    - Half of the time
    - Some of the time
    - None of the time
    - 4 3 2 1 0

11. Places or areas with low humidity, dusty, dry?
    - All of the time
    - Most of the time
    - Half of the time
    - Some of the time
    - None of the time
    - 4 3 2 1 0

12. Areas that are air conditioned?
    - All of the time
    - Most of the time
    - Half of the time
    - Some of the time
    - None of the time
    - 4 3 2 1 0

Subtotal score for answers 10 to 12

Add subtotal A, B, and C to get D

D = sum of scores for all questions answered

Total number of questions answered

D0 = number of questions answered (do not include questions answered N/A)

Please turn over the questionnaire to calculate the patient’s final OSDI score.

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**Evaluating the OSDI Score**

The OSDI is assessed on a scale of 0 to 100, with higher scores representing greater disability. The index demonstrates sensitivity and specificity in distinguishing between normal subjects and patients with dry eye disease. The OSDI is a valid and reliable instrument for measuring dry eye disease severity (mild, mild to moderate, and severe) and effects on vision-related function.

**Assessing Your Patient’s Dry Eye Disease**

Use your answers D and E from Side 1 to compare the sum of scores for all questions answered (D) and the number of questions answered (E) with the chart below. Find the corresponding shade of red in the box below to determine whether your patient’s score indicates normal, mild, moderate, or severe dry eye disease.

![Chart showing OSDI Score](chart.png)

**Patient’s Name:**

**Date:**

**How long has the patient experienced dry eye?**

**Eye Care Professional’s Comments:**

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*Abbott Medical Optics*

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Management of underlying disorders

Eyelid disorders can cause dry eye disease

- Treatment of blepharitis (eyelid inflammation)
  - Eyelid scrubs
  - Antibacterial ointments
  - Steroid drops

- Treatment of ectropion or entropion
  - Blepharoplasty

Sjögren’s dry eye patients are generally managed the same way as non-Sjögren’s
Natural Therapies for Dry Eye

**Blinking**
- Frequent blinking helps spread the tear film evenly and combats evaporation

**Hydration**
- Dehydration can make dry eye symptoms worse

**Environmental changes**
- Use humidifier or air filter
- Avoid fans
- Take breaks from the computer
- Change contact lenses or wear less frequently

**Dietary supplements**
- Omega 3 fatty acids

Office Environment & Dry Eye
Eye irritations in office environment?
Prevalence & symptoms

• 5-40% reported with eye irritation symptoms in office buildings

• symptoms include:
  – burning
  – dry
  – gritty
  – itchy
  – scratchy
  – sore
  – stinging
  – strained eyes

Indoor Air 2006; 16: 258–265
Factors associated with eye irritations in office environments

- Humidity
- Room temperature
- Indoor air velocity
- VDU work
- Contact lens wear
- Makeup
Low relative humidity

Increased Evaporative Rates in Laboratory Testing Conditions Simulating Airplane Cabin Relative Humidity: An Important Factor for Dry Eye Syndrome

- 20% decrease of relative humidity will increase the rate of evaporation by 100%

Eduardo Uchiyama, M.D., Joel D. Aronowicz, M.D., Igor A. Butovich, Ph.D., and James P. McCulley, M.D.  
High room temperature

1°C decrease in room temperature was associated with 19% decrease of reported eye symptoms
Indoor air velocity

- High horizontal or downward air velocity along the head region increases evaporation of water from the eye, causing dry eye symptoms.

Fig. 33 Flow and temperature fields around eyes under various flow conditions. (a) Calm environment: (i) Flow field, (ii) Temperature field; (b) Horizontal uniform flow environment: (i) Flow field, (ii) Temperature field; (c) Downward uniform flow: (i) Flow field, (ii) Temperature field.
VDU work – Task

- Blink frequency during an active computer task with demand on vision and hand-eye coordination was 69% lower than during a passive task like watching a film on a VDU.

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J. H. Skotte · J. K. Nojgaard · L. V. Jørgensen · K. B. Christensen · G. Sjøgaard

The effect of lowering the gaze angle by 25° decreased ocular surface area by 7%
VDU work – Eyelid squint

- Squinting at a computer screen may reduce blink frequency by half.
There is a significant association between the use of eye makeup and a thin lipid layer of the tear film.

Oils in the eye makeup may be able to displace the phospholipids and influence the formation of lipid layer on the cornea.

The frequency of the different thicknesses of the fatty layer in A: controls (N=110), B: office workers (N=70) and C: office workers adjusted for the effects on the distribution of the fatty layer thickness caused by the over-frequency of females using eye make-up and of subjects investigated before 12 h in the office population (N=70). Statistical analysis using Wilcoxon rank sum test: A against B, $P=0.0042$ and A against C, $P=0.0032$.

Ways to reduce dry eye symptoms in office environments

WORKSTATION

1. Relative humidity from 40% - 60%

2. Lowering room temperature may reduce tear film evaporation. The optimal room temperature is between 20 and 22°C

3. Avoid ventilation directed at your eyes

4. Adjust the position of the monitor. Downward gaze may minimize loss of water from the tear film

5. Change font and font size of character displayed on the monitor to avoid squinting

6. Remove glare source to avoid squinting

7. Alternate between work with a high and low degree of visual and cognitive demands

8. Microbreaks every 1-2 minute and exercise of complete blinks help restore normal tear film stability
Basic ingredients of tear supplements

- **Water**: replaces water loss

- **Buffer**: maintains pH of the solution. Contains electrolytes

- **Active ingredient**: A lubricant to reduce friction and/or a demulcent to sooth irritated membranes. Increases ocular surface retention time.

- **Preservative**: Used to prolong the shelf life. Can be toxic to the eye. Not used in all formulations.
Eye drop strategies

Increase retention times

The main limitation of eye drops is their relatively short duration of action: they are effective only while they remain on the eye. The most common way to increase ocular retention is to increase viscosity, so many manufacturers add thickening agents. Newer viscoelastics formulations help to increase retention times without blurring.
Eye drop strategies

Counteract hypertonicity

The tears of dry eye sufferers have an increased osmolarity (the concentration of solutes in a solution) due to a hypertonic tear film. The use of a hypotonic eye drop may address this problem. Hypotonic products include blink intensive tears, TheraTears and HypoTears.

Eye drop strategies

**Avoid older generation toxic preservatives**

It is generally recognised that preservatives do cause sensitivity, especially older preservatives such as BAK\(^1\).

A preservative free solution would be the first choice. However, new generation ‘smart’ preservatives such as Purite or **OcuPure** preservative help combine the best of both worlds.

Thank you for listening