DRY EYE: PATHOLOGY AND TREATMENT TYPES

The underlying disease process in dry eye disease causes deterioration of the tear film, which leads to either mild or more serious forms of the condition. A variety of treatment types may offer symptomatic relief. By Dawn Connelly

REFERRAL ADVICE

Pharmacists are encouraged to refer patients with dry eye disease to a specialist when there is a reasonable level of uncertainty in the history and symptom-informed differential diagnosis.

Refer for same-day specialist

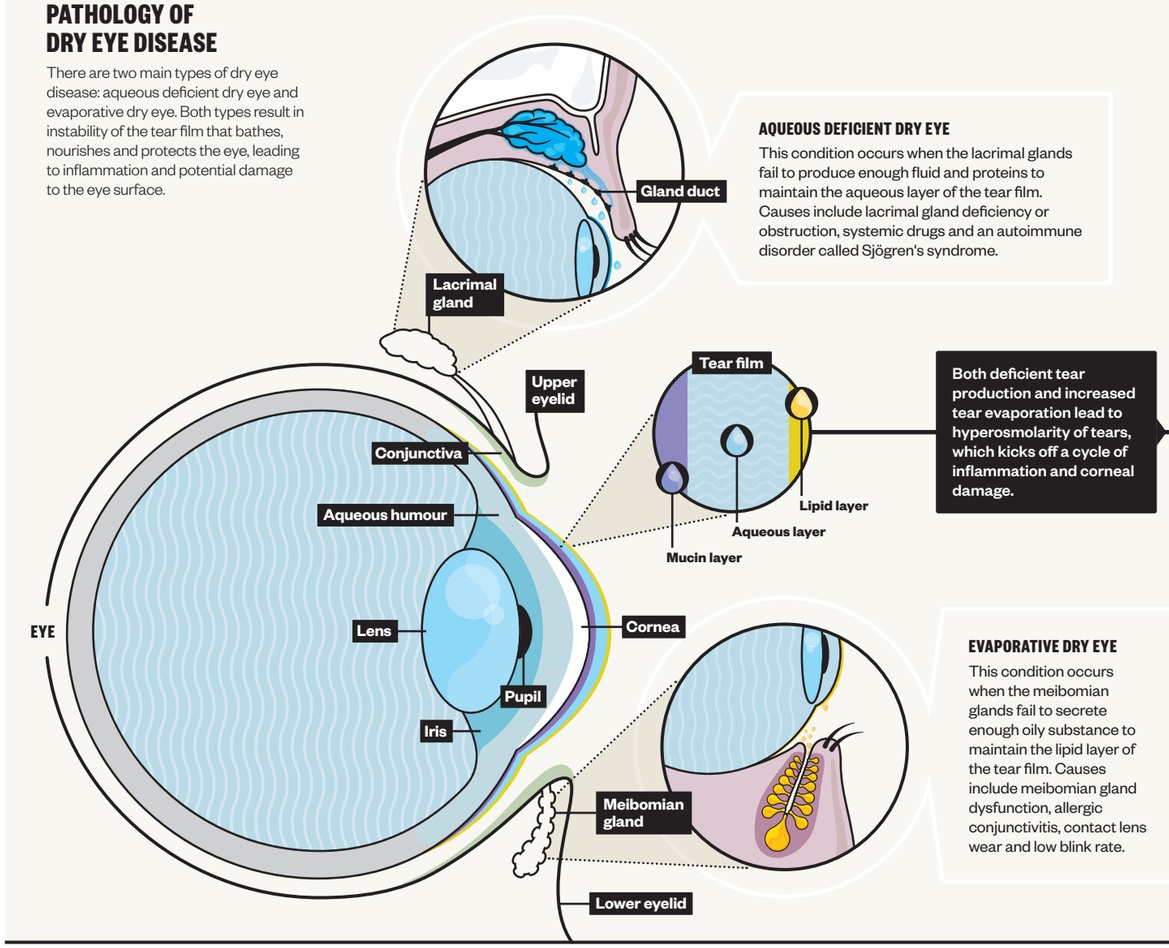
- Symptoms include pain, foreign body sensation or photophobia
- Short-term symptoms with a sudden onset
- Reduction of vision that doesn't return after each blink
- Stickiness, crusting and discharge of the eye
- Marked redness of the eyes

Refer for specialist advice

- One eye affected much more than the other
- Additional dry mouth and other mucosal tissues
- Systemic conditions such as allergy, connective tissue disorders or cancer (treatment)

PATHOLOGY OF DRY EYE DISEASE

There are two main types of dry eye disease: aqueous deficient dry eye and evaporative dry eye. Both types result in instability of the tear film that bathes, nourishes and protects the eye, leading to inflammation and potential damage to the eye surface.



AQUEOUS DEFICIENT DRY EYE

This condition occurs when the lacrimal glands fail to produce enough fluid and proteins to maintain the aqueous layer of the tear film. Causes include lacrimal gland deficiency or obstruction, systemic drugs and an autoimmune disorder called Sjögren's syndrome.

EVAPORATIVE DRY EYE

This condition occurs when the meibomian glands fail to secrete enough oily substance to maintain the lipid layer of the tear film. Causes include meibomian gland dysfunction, allergic conjunctivitis, contact lens wear and low blink rate.

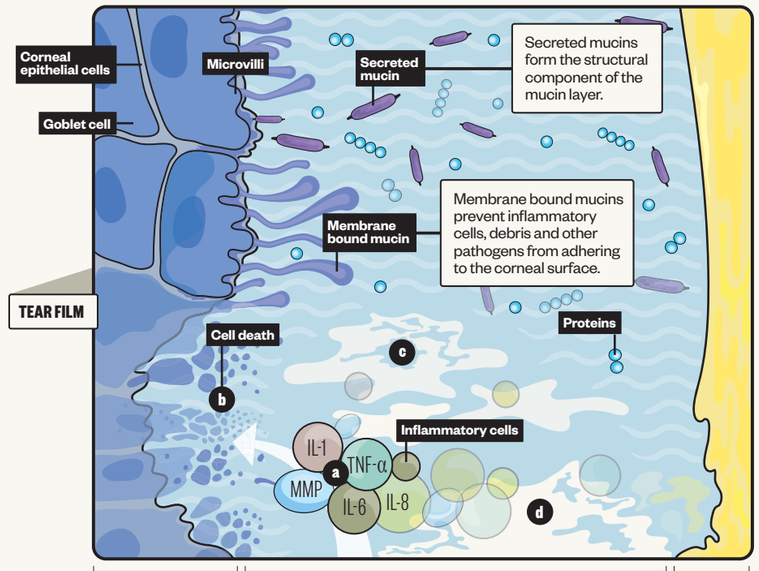
Both deficient tear production and increased tear evaporation lead to hyperosmolarity of tears, which kicks off a cycle of inflammation and corneal damage.

a Tear hyperosmolarity, where the osmolarity of the tear film exceeds that of epithelial cells, stimulates a cascade of inflammatory cytokines and matrix metalloproteinases (MMPs).

b These inflammatory mediators cause apoptotic death of ocular surface cells, including mucin-producing goblet cells located in the conjunctival epithelium.

c Death of ocular surface cells causes the tear film to become unstable and break up quickly before blinking occurs.

d Tear film instability leads to tear hyperosmolarity, and the cycle starts again.



The **mucin or mucus layer** consists of a sponge-like meshwork of fluid and glycoprotein molecules produced by goblet cells. It helps the overlying aqueous layer to spread evenly over and adhere to the eye.

The **aqueous layer** is the thickest layer and contains water, electrolytes, oxygen, proteins and secreted mucin. It keeps the eye moist, maintains pH within physiologic range, delivers oxygen, antibacterial enzymes and antibodies to the corneal surface and helps to remove debris.

The thin **lipid layer** is produced by the meibomian glands and the glands of Zeis (oil glands in the eyelids). It reduces evaporation of the aqueous layer.

TREATMENT

KEY | Designed to mimic: Mucin layer; Aqueous layer; Lipid layer; Other mechanism

MILD DISEASE

Intermittent or mild symptoms can initially be treated with lifestyle advice, such as using humidifiers, smoking cessation, regular screen breaks, increasing omega-3 fatty acid, lid hygiene, warm compresses and massage (for blepharitis and meibomian gland dysfunction), and adjusting contact lenses. If this alone is not sufficient, artificial tears may be indicated and are thought to work by lubrication, replacing missing tear constituents, reducing tear film osmolarity, diluting inflammatory substances or a combination of these. There is no strong trial-based evidence showing that any one product is superior to another.

Hydrogel polymers
Hypromellose drops are recommended as first-line treatment but need to be instilled hourly. Carbomer 980 gel, a viscoelastic lubricant that is thought to bind moisture to the eye surface, can be applied less frequently (four times daily).

Sodium hyaluronate
Sodium hyaluronate is a viscoelastic agent that is thought to lubricate as well as protect the ocular surface, and stays in the eye longer than other lubricants.

Carboxymethylcellulose
Carboxymethylcellulose, a synthetic polymer that is thought to form a viscous eye gel that lubricates the surface of the eye, is often recommended as second-line treatment.

Hydroxypropyl guar
Hydroxypropyl gaur increases in viscosity when in contact with the eye surface, and is thought to form a bioadhesive gel that mimics the mucus layer of the tear film.

Liposomal sprays
Liposomal sprays aim to replenish the oily part of the tear film and are thought to reduce evaporation from the surface of the eye. They are sprayed on to the edges of the eyelids when the eyes are closed.

Soy bean oil
Soy bean oil is an emulsion consisting of an aqueous component and a mixture of natural lipids, which is thought to have lubricating and hydrating properties for the eye surface.

Trehalose
Trehalose is a natural disaccharide found in bacteria, insects, plants and invertebrates, which is thought to act as an osmoprotectant, balancing osmotic pressure within the tear film.

SEVERE DISEASE

For severe dry eye disease, high viscosity lubricants or other products are often required.

Polyvinyl alcohol
Polyvinyl alcohol is a lubricant that is thought to increase the persistence of the tear film.

Liquid paraffin
Liquid paraffin is a high viscosity polymer used to lubricate the eye surface, especially in cases of recurrent corneal epithelial erosion.

Acetylcysteine
Acetylcysteine breaks up sticky mucus in the tear film; often combined with a lubricant (prescription-only medicines [POM]).

Corticosteroids
Corticosteroid drops reduce inflammation but are associated with side effects. Long-term use requires specialist input and supervision (POM).

Ciclosporin
Ciclosporin drops inhibit interleukin-2 activation of lymphocytes and are effective in controlling inflammation, increasing tear secretion and tear film stability, restoring epithelial cell damage and reducing reoccurrences long term (POM).

Pilocarpine
Pilocarpine tablets boost tear production by mimicking acetylcholine, which stimulates the lacrimal glands to make tears (POM).

Serum tear substitutes
Serum tear substitutes are biochemically closer to natural tears than artificial tears (POM).

Contact lenses
Scleral therapeutic contact lenses are used in severe dry eye both for comfort and for improved vision.

PRESERVATIVES

Common preservative benzalkonium chloride can cause conjunctival inflammation, tear film instability, corneal cytotoxicity and a decrease in goblet cells and mucin production. In mild disease, preserved drops are often well tolerated four to six times a day or less. Preservative-free drops are necessary for severe dry eye with ocular surface disease and impairment of lacrimal gland secretion, or for patients on multiple drops.

Graphics: Alisdair Macdonald. Editorial advisers: James Wolffsohn, optometrist and deputy dean of the School of Life and Health Sciences, Aston University, Birmingham; John Dart, ophthalmologist, Moorfields Eye Hospital, London; Shelly Bansal, director, First Contact Opticians, Eastcote, Middlesex. Sources: 2007 Report of the International Dry Eye WorkShop (DEWS); National Institute for Health and Care Excellence; *The Pharmaceutical Journal*