

DRY EYE SYNDROME: AN OVERVIEW!

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ABSTRACT

Dry eye syndrome (also known as *Keratoconjunctivitis sicca*) occurs when there is a problem with the tear film that normally keeps the eye moist and lubricated. The aim of present work is to study dry eye syndrome comprehensively. The causes of dry eye include: ageing, medication, illness, increased evaporation of tears, blepharitis and some unknown causes. The symptoms of dry eyes are – eye irritation, slight blurring of vision, dislike towards bright lights, for contact lens wearer, they may feel uncomfortable. Possible complications of dry eyes are inflammation of the conjunctiva or the cornea at the front of the eye (keratitis). In severe cases, small ulcers may develop on the cornea. If left untreated, loss of vision may occur. Diagnosis includes Schirmer's tear test, tear film break-up time, Rose Bengal staining test and phenol red thread test etc. The goals of treating dry eyes are to control the dryness of the eye, relieve symptoms, improve quality of life, minimize risk factors and prevent ocular damage. Though there is no absolute cure for dry eye syndrome, treatment includes symptomatic relief. Artificial tears, eye ointment and other medications are generally used. Limited data suggest that topical cyclosporine has the potential to reduce physician visits and use of other medications, including artificial tears; however, further research is needed to clarify its impact on both the direct and indirect costs of dry eye.

Keywords: Dry eye syndrome, *Keratoconjunctivitis sicca*, Schirmer's test and artificial tears.

INTRODUCTION

Normal vision requires a moist healthy ocular surface. A sufficient quality of tears, a normal composition of the tear film, normal lid closure, and regular blinking are among the prerequisites to maintain a healthy ocular surface. Tears are made by tissue in the lacrimal glands. The major lacrimal glands lie under the skin and extend into the eye socket. Tears reach the surface of the eye via small openings from the gland. Tears drain from the eye's surface by flowing into other tiny openings (lacrimal puncta), then into canals in the eyelids (lacrimal ducts), into a small pouch (lacrimal sac) and finally into the nose ^{1,2,3}. (Fig 1)

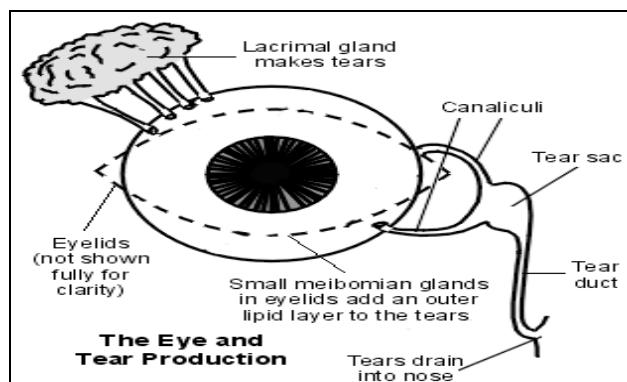


Figure 1: Normal tears turnover

What is Dry Eye Syndrome?

Dry eye syndrome or dry eye (also known as *Keratoconjunctivitis sicca*) occurs when there is a problem with the tear film that normally keeps the eye moist and lubricated⁴. It can occur as a result of various conditions.

Dry eye is a disorder of the tear film due to tear deficiency or excessive tear evaporation that causes damage to the interpalpebral ocular surface (i.e. exposed eye surface) and is associated with symptoms of ocular discomfort^{4,5}. This condition is the inability to produce enough tears to keep the surface of the eyes lubricated and comfortable. The eye becomes dry either because there is not enough tears being produced or because there is abnormally high rate of evaporation of tears⁶. Dry eye is a disease of the ocular surface attributable to different disturbances of the natural function and protective mechanisms of the external eye, leading to an unstable tear film during the open eye state⁷.

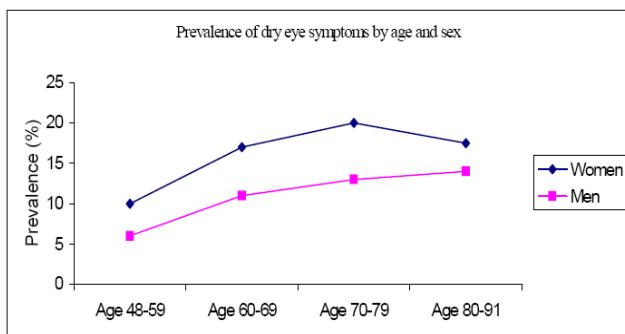
Dry Eye Prevalence

Dry eyes can affect anyone, but it becomes more common with increasing age⁷. A dry eye affects about 7 % people in their 50s, and about 15 % people in their 70s^{8,9}. Women are affected more often than men. An estimated 12 million Americans have dry eyes¹⁰. According to study where patients with eye problems are interviewed and their diagnostic reports were studied. Following data reveals the prevalence of dry eye syndrome in some countries^{7,8}. (**Table 1**) (**Fig 2**)

Table 1: Prevalence of dry eye

Study Centre	No. of patients	Prevalence (%)
Japan	2127	17
Denmark	504	11
USA	2520	15
Australia	926	16



**Figure 2:** Prevalence of dry eye**Increasing prevalence of dry eye^{8, 11}**

- Increasing life span of the population
- Expansion of consumption of medications
- Increase in number of people wearing contact lenses
- Increase in computer usage
- Increase in number of patients undergoing LASIK

Symptoms^{12, 13, 14}

- Irritation
- Redness
- Burning/ Stinging
- Itchy eyes
- Sandy- gritty feeling (foreign body sensation)
- Blurred vision
- Tearing
- Contact lens intolerance
- Increased frequency of blinking
- Mucous discharge
- Photophobia (less frequent symptom)
- Symptoms worsen in windy or air-conditioned environments as day progresses after prolonged reading, working on computers

Possible complications

Complications are uncommon. Inflammation of the conjunctiva (conjunctivitis) or the cornea at the front of the eye (keratitis) sometimes occurs. In severe cases, small ulcers may develop on the cornea. Rarely, the corneal tissue may perforate (puncture). Eyes become red or vision may be affected (more than slight temporary blurring). In some cases eye pain develops other than the grittiness or irritation that goes with dry eyes. These are not normally symptoms of dry eyes and may indicate another eye condition or a complication of dry eyes⁷.

Dry eye may be sight threatening

When serious complications occur there is danger of loss of eyesight. In case of bacterial keratitis and corneal ulcer there are great chances of blindness, hence it is advised to take utmost care in such complications⁸. (**Fig 3 & 4**)

**Figure 3:** Corneal ulcer**Figure 4:** Bacterial keratitis**Classification of Dry Eye⁴**

Dry eye is classified into two major categories viz. Evaporative Dry Eye and Tear-Deficient Dry Eye. In first category there is excess evaporation of tear film causing Dry Eye and there is less production and /or secretion of tear in later. (**Table 2**)

Dry Eye: Main Causes^{15, 16, 17, 18}

- **Ageing:** People tend to make fewer tears, as they get older. In particular, some women notice dry eyes developing after the menopause.
- **Medication:** Some drugs sometimes have a side effect of causing dry eyes or make dry eyes worse. These include: diuretics ('water tablets'), some antidepressants, antihistamines, some treatments for anxiety and other psychological problems, the contraceptive pill, beta-blockers such as propranolol, atenolol etc; some eye drops used to treat other eye conditions. This is not an exhaustive list.
- **Illness:** Some people develop dry eyes as a symptom of a more general disease. For example, dry eyes may occur with rheumatoid arthritis, systemic lupus erythematosus and Sjogren's syndrome. In these situations patients would normally have other symptoms in other parts of the body. For example, joint pains. Meibomian gland disease is also important cause of dry eye.



- Increased evaporation of tears:** This may be due to:
 - Low humidity. For example, from central heating or air conditioning.
 - Low blink rate, often combined with opening eyes wider than normal. For example, spending a long time looking at a computer, TV or microscope.
 - Windy conditions when you are outside.
 - Inability to completely cover the eyes when closing the eyelids. For example, due to eye problems that some people have related to

thyroid disease. Also, some people sleep with their eyes partly open.

- Damage** to the outer part of the eyes, eyelids, etc, from disease, injury or surgery.
- Blepharitis** (inflammation of the eyelids) is often associated with dry eyes.
- Unknown:** Some younger people have no apparent cause. They simply produce less than the normal amount of tears.

Table 2: Dry eye classification

Evaporative Dry Eye	
Environmental factors	Central heating (forced air dry heat), hair dryer, car windscreen demisting, air travel, dry climates, wind, air pollution (cigarette smoke), contact lens wear (reduced blinking), driving, watching TV, computer work, reading.
Eyelid Inflammation	Blepharitis, rosacea & meibomian gland dysfunction are major causes of this form of dry eyes.
Lid surfacing anomalies	Tears are not spread adequately over the eye surface due to proptosis, ectropion, entropion, nocturnal lagophthalmos, Bell's palsy, pterygium/pingecula, conjunctival chalasis.
Tear-Deficient Dry Eye	
Sjogren's syndrome (dry eye + dry mouth + arthritis)	Patients with Sjogren's syndrome not only have dry eyes but also have dry mouth. Blood tests show the presence of several antibodies (SS-A or SS-B, ANA and RF). Connective tissue diseases (Rheumatoid arthritis, lupus etc) may also be present.
Non-Sjogren's syndrome	Patients with non-Sjogren's dry eyes do not produce tears because of a disease of the tear gland. Examples of diseases that can cause dry eye in this fashion include: sarcoidosis, Vitamin A deficiency, trachoma and trauma. Chronic contact lens wear, past herpes eye infection, diabetes and aging are other causes.

Dry eye diagnostic tests^{6, 18, 19, 20, 21, 22}

There are various diagnostic methods for dry eye. These methods are used to study the tear secretion, tear film integrity, and tear stability, physical as well as chemical composition of tear and histological study. Following are some important diagnostic tests for dry eye.

1. Tear film break-up test

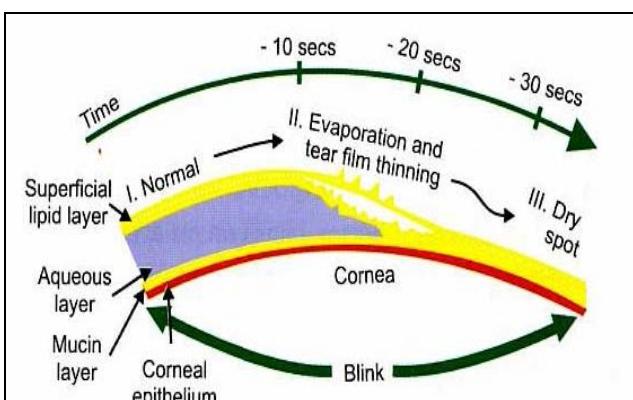


Figure 5: Tear break up- time test

This is used to find out the stability/instability of tear film in all different causes of dry eye. It may be invasive with fluorescein and non-invasive with toposcope. Here time required for breaking the tear film is determined. In severe dry eye it is minimal.

Values of < 10 seconds are considered abnormal

Values of 5-9 seconds are borderline dry eye

Values of < 5 seconds are clearly indicative of dry eye
(Fig 5)

2. Fluorescein clearance test

Tear turnover is important for removing inflammatory cytokines providing fresh supply of growth factors. Delayed clearance of tears from the eye is thought to be a contributing factor in pathogenesis of dry eye. Delay tear clearance strongly correlates with ocular irritation symptoms independent of aqueous tear production. Standardized amount of fluorescein is placed in conjunctival sac and tear turnover rate is determined by persistent of fluorescein in tears at specific time points later



3. Tear film Osmolarity

In dry eye tear film is in a hyperosmolar state due to decrease production of tear, decrease lipid content of tear, decreased film stability and increased evaporation of tear film. A commercial osmometer specifically designed to test nanometer volume of tear is now in use but is not widespread due to cost consideration

Normal value for tear Osmolarity = 300-310 mOsm/l

4. Secondary tests to determine the specific causes of the dry eye

There are certain diagnostic tests, which are used to determine specific causes of the dry eye. Such tests are Schirmer's test, diagnostic dye staining, nasolacrimal reflex, meibomian gland evaluation, impression cytology and tear protein analysis etc. Among these tests Schirmer's test is widely used.

A. Schirmer's test: The most commonly used technique for assessment of tear secretion described in 1903 by a German ophthalmologist Otto Schirmer. The Schirmer strip is placed over the lateral third of the lower lid. If using an anesthetic, adequate time should be given after the drop to minimize reflex tearing from the burning sensation due to drop. Schirmer's test is performed with and without anesthesia.

- Schirmer I (without anesthesia): It determines the basic and reflex secretion
- Schirmer II (with anesthesia): It determines only basic secretion
 - <5mm wetting in 5 min is sign of clinical dry eye
 - 5-10mm wetting suggests borderline dry eye
 - >10mm wetting represents normal secretion (Fig 6)



Figure 6: Schirmer's test

B. Diagnostic dye staining: The installation of dyes is a common method to detect ocular surface epithelial pathology associated by dry eye. Dyes like Fluorescein sodium, Rose Bengal, lissamine green are commonly used.

Fluorescein is the most commonly used dye, which stains the cornea more than conjunctiva. Significantly greater amount of staining observed in Sjogren's aqueous tear deficiency.

Rose Bengal unlike fluorescein, which stains tissue by penetrating into intercellular spaces. Conjunctiva usually

stains more intensity than the cornea. The intensity of rose Bengal staining correlates well with the degree of aqueous tear deficiency. (Fig 7)



Figure 7: Rose Bengal staining

Lissamine green B similarly stains with Rose Bengal.

- Produces much less irritation
- Staining pattern identical to Rose Bengal
- When score >5 indicated diagnosis of Sjogren's syndrome

Treatment/Management for dry eye syndrome^{23, 24, 25}

The goals of treating dry eyes are to control the dryness of the eye, relieve symptoms, improve quality of life, minimize risk factors and prevent ocular damage. Though dry eyes cannot be cured, there are a number of steps that can be taken to treat them. Treatments for dry eyes may include:

Artificial tear drops and ointments: The use of artificial teardrops is the primary treatment for dry eye. Artificial teardrops are available over the counter in many countries. No one drop works for everyone, so one has to experiment to find the drop that works for him. In chronic dry eye, it is important to use the drops even when your eyes feel fine, to keep them lubricated. If eyes dry out even while sleep, use of a thicker lubricant, such as an ointment, at night is necessary.

Temporary punctal occlusion: Sometimes it is necessary to close the ducts that drain tears out of the eye. This is done via a painless procedure where a plug that will dissolve quickly is inserted into the tear drain of the lower eyelid. This is a temporary procedure, done to determine whether permanent plugs can provide an adequate supply of tears.

Permanent punctal occlusion: If temporary plugging of the tear drains works well, then silicone plugs (punctal occlusion) may be used. The plugs will hold tears around the eyes as long as they are in place. They can be removed. Rarely, the plugs may come out spontaneously or migrate down the tear drain. Many patients find that the plugs improve comfort and reduce the need for artificial tears.

Restasis: In 2002, the USFDA approved the prescription eye drop Restasis (containing cyclosporine A) for the treatment of chronic dry eye. It is currently the only



prescription eye drop that helps eyes to increase their own tear production with continued use.

Other medications: Other medications, including topical steroids, secretagogues may also be beneficial in some cases.

Surgery: If needed, the ducts that drain tears into the nose can be permanently closed to allow more tears to remain around the eye. This is done with local anesthetic on an outpatient basis. There are no limitations in activity after having this surgery.

Among above options tear substitutes have certain benefits. The composition of tear substitutes has great resemblance with natural tears, hence they are popularly known as 'Artificial tears'.

Tear substitutes benefits^{25, 26}

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.

Economic implications¹⁷

Relatively few data exist on direct and indirect costs of dry eye and its sequelae. Likely, this is due to the fact that until recently, when the etiology of this common disease became more fully understood, dry eye was viewed largely as an irritant and not necessarily a serious condition worthy of medical attention. Emerging scientific knowledge about dry eye may prompt payers or the government to conduct comprehensive data analyses of the economic impact of dry eye. There are significant comorbidities, associated diseases, and behavioral and environmental factors that may contribute to the severity of dry eye. Dry eye syndrome has significant economic implications, including costs associated with increased health care utilization, missed school and work, and leisure and quality-of-life issues. Dry eye presents important economic challenges to patients, physicians, and health care delivery organizations. Data from a large US managed care database suggest that the prevalence of clinically diagnosed dry eye disease (DED) is 0.4% to 0.5% overall, and is highest among women and the elderly. The burden of DED to the patient can be substantial, impacting visual function, daily activities, social and physical functioning, workplace productivity, and quality of life (QOL). Preliminary analysis suggests that DED also has a considerable economic impact in terms of both direct and indirect costs. A number of therapies have been shown to improve DED signs and symptoms, but few clinical trials have addressed QOL and economic issues.

Limited data suggest that topical cyclosporine has the potential to reduce physician visits and use of other medications, including artificial tears; however, further research is needed to clarify its impact on both the direct and indirect costs of DED.

CONCLUSION

Dry eye syndrome has significant prevalence around the globe. Female and elderly persons are more affected than other groups. There are various reasons for dry eye; most. The diagnosis for dry eye includes different tests such as tear film break-up tests, Schirmer's test, rose Bengal staining test, phenol red thread tests etc. Artificial tear drops and ointments, temporary/permanent punctal occlusion and other medication like topical steroids and Restasis are used for the treatment of dry eye syndrome. Artificial tears are most common and popular among ophthalmologists as well as patients. Dry eye presents important economic challenges to patients, physicians, and health care delivery organizations. Emerging scientific knowledge about dry eye may prompt payers or the government to conduct comprehensive data analyses of the economic impact of dry eye.

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