8-2007

Contact lens-related dry eye: A literature review

Tochuku C. Nkadi
Pacific University

Contact lens-related dry eye: A literature review

Abstract

Contact lens-related dry eye: A literature review

Degree Type

Dissertation

Degree Name

Master of Science in Vision Science

Committee Chair

Jennifer L. Smythe

Subject Categories

Optometry

CONTACT LENS-RELATED DRY EYE: A LITERATURE REVIEW

BY

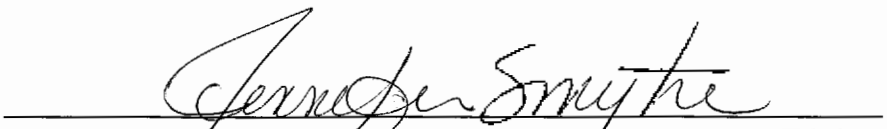
TOCHUKU C. NKADI

A thesis submitted to the faculty of the
College of Optometry
Pacific University
Forest Grove, Oregon
For the degree of
Master of Science in Clinical Optometry.
August, 2007

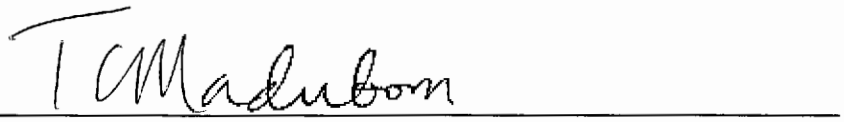
CONTACT LENS-RELATED DRY EYE: A LITERATURE REVIEW

BY

TOCHUKU C. NKADI



ADVISOR: JENNIFER L. SMYTHE, OD, MS, FAAO.



TOCHUKU C. NKADI.

BIOGRAPHY OF THE AUTHOR

Tochuku C. Nkadi was born in Lincoln, Nebraska. She grew up both in the US and in Nigeria. She received a Doctor of Optometry degree from the University of Benin, Benin City, Nigeria in 1999. Tochuku completes the requirements for the Master of Science in Clinical Optometry Degree in August, 2007 and will graduate with a Doctor of Optometry degree from the Pacific University College of Optometry in January, 2008.
She currently lives with her husband, Paul and daughter, Chinye in Hillsboro, Oregon and plans to work in private practice.

ACKNOWLEDGEMENTS

The author would first of all, like to thank the good Lord for all his blessings. I would also like to thank Dr. Jennifer Smythe for accepting to be my advisor for this thesis. I remain eternally grateful to my dear husband, Paul for all his love and unwavering support throughout these 3 years. I could not have done it without him. I also want to thank our lovely daughter, Chinye for being patient with Mommy all the times I had to study instead of being with her. I thank my entire family; parents-Dr. & Mrs. Madubom, my sister, Onyeka and brother, Chijioke for their love and support too.
God bless you all.

CONTACT LENS THESIS: CONTACT LENS RELATED DRY EYE

INTRODUCTION:

Ocular dryness is the most common complication associated with soft contact lens wear. Approximately four out of five lens wearers report symptomatic dryness during some portion of their wearing schedule. Two million individuals abandon soft contact lens wear each year. Nearly 50% of them attribute dryness or discomfort as the primary reason [1, 2.]
A contact lens is a corrective, cosmetic, or therapeutic lens usually placed on the cornea of the eye. Contact lenses usually serve the same corrective purpose as conventional glasses, but are lightweight and virtually invisible — many commercial lenses are tinted a faint blue to make them more visible when immersed in cleaning and storage solutions. Some cosmetic lenses are deliberately colored for altering the appearance of the eye.

It has been estimated that about 125 million people use contact lenses worldwide, accounting for about 2% of the population and that about 28 to 38 million people in the United States [3, 4] and 13 million in Japan wear contact lenses [5.]

Chapter 1

I. TYPES OF CONTACT LENSES.

There are various types of contact lenses based on; the construction material used to make the lenses, the wear, and replacement schedules.

A. The construction material used to make the lenses:

The first contact lenses were made of glass, which caused eye irritation, making it difficult to be worn for extended periods of time. When William Feinbloom introduced lenses made from polymethyl methacrylate (PMMA or Perspex/Plexiglas), contacts became much more convenient [6].

These PMMA lenses are commonly referred to as hard lenses. However, PMMA lenses have their own side effects: no oxygen is transmitted through the lens to the cornea, which can cause a number of adverse clinical events. In the late 1970s, and through the 1980s and 1990s, improved rigid materials which were also oxygen-permeable were developed. Collectively, these polymers are referred to as rigid gas permeable or 'RGP' materials or lenses.

Rigid lenses offer a number of unique properties. In effect, the lens is able to replace the natural shape of the cornea with a new refracting surface. This means that a regular rigid contact lens can provide good level of vision in people who have astigmatism or distorted corneal shapes as with keratoconus.

Whilst rigid lenses have been around for about 120 years, soft lenses are a much more recent development. The principal breakthrough in soft lenses made by Otto Wichterle led to the launch of the first soft (hydrogel) lenses in some countries in the 1960s and the approval of the 'Soflens' material (polymacon) by the United States FDA in 1971 [6]. Soft lenses are immediately comfortable, while rigid lenses require a period of adaptation before full comfort is achieved. The polymers from which soft lenses are manufactured improved over the next 25 years, primarily in terms of increasing the oxygen permeability by varying the ingredients making up the polymers.

A small number of hybrid rigid/soft lenses exist. An example of this type of lens is the SynergEyes lens, which is made up of a rigid gas permeable lens in the center and surrounded by a soft lens "skirt". An alternative technique is piggybacking of contact lenses, a smaller, rigid lens being mounted atop a larger, soft lens. This is done for a variety of clinical situations where a single lens will not provide the optical power, fitting characteristics, or comfort required.

In 1999, 'silicone hydrogels' became available. Silicone hydrogels have both the extremely high oxygen permeability of silicone and the comfort and clinical performance of the conventional hydrogels. These lenses were initially advocated primarily for extended (overnight) wear, although more recently daily wear silicone hydrogels have been launched[7].

While it provides the oxygen permeability, the silicone also makes the lens surface highly hydrophobic and less "wettable." This frequently results in discomfort and dryness during lens wear. In order to compensate for the hydrophobicity, hydrogels are added to make the

lenses more hydrophilic. However, the lens surface may still remain hydrophobic. Hence some of the lenses undergo surface modification processes which cover the hydrophobic sites of silicone. Some other lens types incorporate internal rewetting agents to make the lens surface hydrophilic

B. The wear schedule:

A daily wear contact lens is designed to be removed prior to sleeping. An extended wear (EW) contact lens is designed for continuous overnight wear, typically for 6 or more consecutive nights. Newer materials, such as silicone hydrogels, allow for even longer wear periods of up to 30 consecutive nights; these longer-wear lenses are often referred to as continuous wear (CW). Generally, extended wear lenses are discarded after the specified length of time. These are increasing in popularity, due to their obvious convenience. Extended- and continuous-wear contact lenses can be worn for such long periods of time because of their high oxygen permeability which allows the eye to remain remarkably healthy. This high oxygen permeability is typically 5-6 times greater than conventional soft lenses [7].

Extended lens wearers may have an increased risk for corneal infections and corneal ulcers. This is primarily due to poor care and cleaning of the lenses, tear film instability, and bacterial stagnation. Neovascularization of the cornea has been a common complication of extended lens wear, but does not appear to be a problem with silicone hydrogel extended wear. The most common complication of extended lens use is usually allergic or giant papillary conjunctivitis (GPC), sometimes associated with a poorly fitting contact lens [6].

C. The replacement schedule:

The various soft contact lenses available are often categorized by their replacement schedule. The shortest replacement schedule is single use (daily disposable) lenses, which are disposed of each night. These may be best for patients with ocular allergies or other conditions, because it limits deposits of antigens and protein. Single use lenses are also useful for people who use contacts infrequently, or for purposes where losing a lens is likely e.g. swimming or other sporting activities. More commonly, contact lenses are prescribed to be disposed of on a two-week or monthly basis. The use of quarterly or annual lenses has lost favor because a more frequent disposal schedule allows for thinner lenses and limits deposits. Rigid gas permeable lenses are very durable and may last for several years without the need for replacement [7].

II. DRY EYE.

Dry eye is defined as a disorder of the tear film as a result of tear deficiency and/or tear evaporation that causes damage to the ocular surface and is associated with symptoms of ocular discomfort [8]. Dry eye is a group of conditions in which deficiencies in production of aqueous, mucin, and lipid and lid resurfacing problems lead to a continuum from marginal dysfunction to serious pathological conditions. As a result, it is categorized as pathological or borderline (marginal) dry eye.

Pathological dry eye is a condition in which the patient has underlying systemic or ocular surface disease that contributes to or causes the disorder. This category also includes patients who have suffered ocular trauma such as physical or chemical burns, and those

taking ocular or systemic medications that affect tear film stability or production. Pathologic causes of a decrease in tear production include Sjogren's syndrome, vitamin A deficiency, age-related hyposecretion, lacrimal gland excision or damage as a result of sarcoidosis or cancer, sensory motor loss and conjunctival scarring conditions, and burns. Chronic allergic conjunctivitis and collagen vascular disorders such as scleroderma, lupus and rheumatoid arthritis commonly cause dry eye disease, as does ocular surface disease. In addition, several classes of systemic medications can compromise tear film production including antihistamines, thiazide diuretics, antidepressants and other antihypertensives. Pathologic cases are typically the only form of dry eye that have a definitive correlation between objective testing and subjective symptoms. These highly symptomatic patients have reduced tear break-up time, tear production deficiency, and/or ocular surface damage in the form of conjunctival or corneal staining [1].

Borderline or marginal dry eye becomes manifest only in the presence of provocative stimuli. These stimuli can include environmental factors such as low humidity, air conditioning, or occupations such as reading where the blink rate is reduced. Drugs that affect tear film also make a borderline dry eye patient symptomatic. The borderline dry eye patient may remain undetected until the provocative stimulus causes sufficient disruption to the fragile tear film to cause anterior surface abnormalities and symptoms. From the point of view of the contact lens practitioner, the most significant stimulus is the wearing of contact lenses.

McMonnies et al. showed that dry eye symptoms are more frequent in contact lens wearers than in nonwearers, indicating that contact lens wear is a provocative condition for dry eye

symptoms [9]. The Canadian Dry Eye Epidemiology Study (CANDEES) confirmed that dry eye symptoms were more prevalent in contact lens wearers. It was found that virtually half of the contact lens wearers (50.1%) experienced dry eye symptoms compared with just 21.7% of the non-lens wearers [2]. Some practitioners claim that dry eye is the largest contributor to failure in contact lens fitting. Dry eye symptoms are widespread among contact lens wearers [2]. A survey of practitioners in the United States showed that 18 to 30% of soft contact lens patients had symptoms of dry eye, 12 to 21% were symptomatic enough to reduce their contact lens wearing time, and 6 to 9% could not wear contact lenses because of dryness symptoms [10].

This work aims to review the number one reason why patients discontinue contact lens wear-dry eye- and will figure out why that is as well as the best way optometrists can help these contact lens patients overcome this problem.

Chapter2-Composition of the tear film

I. THE TEAR FILM.

The tear film is formed by glands in the eyelids, conjunctiva and the lacrimal glands. It is distributed over the ocular surface by the action of the eyelids, from where it, evaporates, or drains via the nasolacrimal ducts. The tear film contains lactoferrin, lysozyme, immunoglobulins and cells, including polymorphonuclear leukocytes and macrophages, which prevent infection [11]. An adequate tear film is essential for maintaining the health of the ocular surface and the optical quality of the eye. It also provides lubrication [8].

The integrity of the tear film is critical for safe and comfortable contact lens wear. If the tear film is of insufficient quantity or quality, the patient generally complains of having a "dry eye". In the contact lens field, the term dry eye is taken as an all encompassing phrase that encapsulates various aspects of tear film dysfunction relating to contact lens wear. These aspects include, but are not restricted to patient symptomatology, alterations to tear chemistry, lens deposition, effects on tissue integrity and vision, infection and lens performance.

In order to develop current treatment recommendations for dry eye disease 17 international specialists on dry eye agreed to participate in a modified 2-round panel approach in Delphi. During this panel a new term for dry eye disease was proposed: Dysfunctional Tear Syndrome (DTS). The panelists at the meeting unanimously recommended this change because they agreed that the dry eye label reflects neither patient symptoms nor necessarily the pathogenic mechanism of the disease. All patients with this condition do not necessarily

suffer from reduced tear volume but may rather have abnormalities of tear film composition that include the presence of proinflammatory cytokines. Thus deeming the term DTS as more appropriate. This shows how important the tear film is to the overall function of the eye [12]. The tear film in contact lens wear differs in many ways from the normal, undisturbed tear film. The most obvious difference from a clinical perspective is a necessary structural reorganization whereby the tears are compartmentalized into the pre-lens tear film and post-lens tear film. The integrity of the tear film remains altered for a short period after the removal of contact lenses from the eye [13].

A. The structure of the tear film:

There are a couple of models of the tear film structure in the literature, but the most useful, clinically relevant and accepted model is as follows:

The tear film is about 7 μm thick and is composed of an outer lipid layer, an intermediate aqueous layer and an inner mucous layer.

1. Lipid layer:

This layer contains oils secreted by the meibomian glands. The supply of these oils to the eye depends on their secretion from the meibomian glands and the eye blinking. It is believed that there is a steady secretion of oil onto the eyelid margin over 24 hours, but that this is aided by the blink during waking. This layer of the tear film coats the aqueous layer to provide a hydrophobic barrier that retards evaporation and prevents tears from spilling onto the cheek.

2. The Aqueous layer:

This is a thicker layer secreted by the lacrimal and accessory lacrimal glands of Krauss and Wolfring. This layer contains water and other substances such as proteins e.g. tear lipocalin, lactoferrin, lysozyme and lacritin. The aqueous layer serves to promote spreading of the tear film and control of infectious agents.

3. The Mucus layer:

This layer is produced by the goblet cells of the conjunctiva. It contains many chemicals some of which are mucins. These were originally believed to be formed entirely by the goblet cells of the conjunctiva; recent studies have shown that surface epithelial cells of the cornea and conjunctiva also express a variety of mucins. It coats the cornea to provide a hydrophilic layer that allows for even distribution of the tear film [8].

B. Functions

The function of the tear film in a non –contact lens wearer or 'normal eye' is as follows:

1. Optical: The tear film maintains an optically uniform interface between the air and the cornea.

2. Mechanical: The tear film acts as a vehicle for the continual blink –mediated removal of debris that constantly enters the eye.

3. Lubrication: The tear film ensures a smooth movement of the eyelids over the globe during blinking.

4. Bactericidal: The tear film contains defense mechanisms in the form of proteins, antibodies, phagocytotic cells and other immunodefense mechanisms that prevent ocular infection.

5. Nutritional: The tear film provides the corneal epithelium with the necessary supplies of oxygen.

6. Waste removal: The tear film acts as an intermediate reservoir for the removal of by-products of metabolism from the cornea, such as carbon dioxide and lactate [10].

An unstable tear film is pathognomonic of a dry eye, and may be due to alterations in the composition, volume or the hydrodynamics of the fluid. A deficiency in one or more of the tear film layers, and /or increased tear evaporation will cause a dry eye.

The act of blinking spreads the tear film over the surface of the eye. This is mainly due to the action of the upper eyelid which spreads the tear film from the lacrimal gland and the accessory lacrimal glands of Krause and Wolfring. In addition, as the eyelid closes, it dips into the tear reservoir formed at the margin of the lower eyelid, and spreads this over the ocular surface as the eyelids open.

The mainly horizontal movement of the lower eyelid assists in the expulsion of the tear film from the eye via the nasolacrimal duct. The movement of the globe also aids distribution of the tears. Inadequate and incomplete blinking is a common cause of dry eye symptoms in the contact lens wearer.

Chapter 3

DIAGNOSING/ EXAMINING A PATIENT WITH DRY EYE.

A dry eye was defined by the National Eye Institute/ Industry workshop in 1993/1994 as "a disorder of the tear film due to tear deficiency or excessive tear evaporation that causes damage to the interpalpebral ocular surface and is associated with symptoms of ocular discomfort" [8]. This ocular surface damage may extend beyond the interpalpebral area, be present in patients who are asymptomatic, but meet all other criteria for dry eye, and patients who have symptoms but in whom signs may be absent.

The workshop classified dry eye disease as:

1. Tear- deficient dry eye, which includes Sjogren's and non-Sjogren's disease due to an aqueous deficiency.

2. Evaporative dry eye, including contact lens-related dry eye [8].

.

I. DIAGNOSIS

The most important way of diagnosing a patient with dry eye is the case history. A questionnaire can be very helpful in determining if a patient has dry eye. Several surveys have been carried out and results of these surveys helped find out the most common symptoms reported by dry eye patients:-

Some of the wide variety of symptoms of dry eye that patients complain of include: Gritty sensation, foreign body sensation, burning and /or stinging, photophobia, symptoms usually worse as the day progresses, but may be present on waking. It is thought that a diurnal variation of symptoms and exacerbation by certain activities are indicative of dry eye disease. Symptoms usually become worse during the day, but may be present on waking, which may reflect reduced aqueous production during sleep. Long periods of reduced blinking, air conditioning and the low humidity in aircraft cabins all exacerbate the condition.

A. Assessment of tear film stability.

1. Tear break-up time (TBUT) with fluorescein: This is carried out using a small quantity of fluorescein, which is instilled into the lower fornix using an applicator. The patient is asked to blink and then keep their eyes open. The time taken for the first defect to appear is recorded as the TBUT. The tear film is best viewed using a cobalt blue filter.

2. Non-invasive break-up time (NIBUT): This is the time taken between the last blink and the break-up of the reflected image of a target. A number of commercially available instruments like the Keeler tear scope for making direct and indirect measurements. The videokeratoscope may also be used too. In this instance the patient is asked to blink and the concentric, circular black and white mires are viewed on the screen and the time taken for the first distortion of the mires to appear is recorded. A recording of less than 10 seconds on either the TBUT or NIBUT indicates a dry eye.

B. Ocular surface damage

1. Fluorescein staining: - Fluorescein is a non-toxic dye, and staining by it indicates increased epithelial permeability of the cornea or conjunctiva. It will stain punctate and ulcerative lesions and by coloring the tear film, will outline non-staining raised lesions. A good view is obtained with the cobalt blue filter of the slit lamp. Fluorescein should be washed out of the eye before inserting contact lenses-otherwise the lenses will become stained.

2. Rose Bengal staining: - Rose Bengal stains dead and degenerating conjunctival cells and corneal epithelial filaments dark pink. It is toxic to the epithelium and causes pain on instillation-so only small amounts should be used. If it comes into contact with a soft contact lens it cannot be removed. In some cases it may be necessary to use topical anesthesia.

3. Lissamine Green: - Similar to Rose Bengal, but better tolerated.

Grading surface damage: - Surface damage of the cornea and conjunctiva can be graded using a grading scheme in which each area is graded from 0-3, and the final score is the sum of all the areas.

C. Assessing aqueous tear flow.

One method of measuring this is by a Schirmer's Test. This test may be performed with or without the use of a local anesthetic. For these tests, a strip of filter paper is placed in the

lower fornix, and the amount of filter paper that becomes wet in a given amount of time is measured.

1. Schirmer 1 test (without anesthetic):- This measures the reflex tear secretion, but the result depends on temperature, humidity, and evaporation. Avoid touching all but the end of the strip to prevent skin secretions affecting the result. The patient should blink normally during the test. A dry eye is present if less than 5.5 mm of the strip is wet in 5 minutes. This test gives a lower value than without anesthetic. The greater the length of the wetting, the greater the tear volume.

2. Schirmer II test- with nasal stimulation: - This test assesses the accessibility of the lacrimal gland to reflex stimulation. The test involves rigorous nasal stimulation and is unpleasant to perform.

3. Phenol red thread test: - A thread impregnated with phenol red which turns the thread yellow in air, is inserted into the temporal side of the lower fornix for 15 seconds. The alkaline pH of the tears changes the color of the thread from yellow to red. The greater the passage of redness down the thread, the greater the tear volume. The wetted length is proportional to the aqueous tear production. Some researchers found this to be more reproducible and more specific when compared to Schirmer's.

II. TEAR FILM DISORDERS / CAUSES OF DRY EYE:

Tear film disorders can be classified as aqueous deficiency, Lipid deficiency, Mucus deficiency and evaporative deficiency.

A. Aqueous deficiency

1. Sjogren's disease is a disease of the exocrine glands affecting the lacrimal and salivary glands. It may be primary or secondary.

a. Primary Sjogren's disease is characterized by dry eyes and a dry mouth, a deficiency of aqueous, and autoantibodies in the blood.

b. Secondary Sjogren's disease exhibits the same characteristics as the primary disease, but there are clinical signs of autoimmune connective tissue disease. These diseases are most commonly rheumatoid arthritis, systemic lupus erythematosus etc.

2. Reduced stimulus/Corneal sensitivity: - Neurogenic dry eye may result from damage to the trigeminal nerve (CN V) or facial nerve (CNVII). Loss of corneal sensation normally provided by the ophthalmic division of the trigeminal nerve results in a reduction in reflex tear flow. Damage to the facial nerve, which provides secretomotor fibers to the lacrimal gland, reduces both basal and reflex secretion [8].

B. Mucus Deficiency

Conjunctival scarring conditions such as erythema multiforme (Stevens-Johnson syndrome), cicatricial pemphigoid or thermal or chemical burns destroy the goblet cells and

therefore reduce mucus production. This results in poor distribution and instability of the tear film across the ocular surface.

C. Lipid Deficiency.

This category involving altered lipid layer includes: Meibomian gland disease and Blepharitis (Staphylococcal, Seborrheic).

1. Meibomian gland disease (MGD): is defined as a bilateral clinical condition in which there is a change in the lipid appearance from a normally clear state to a viscous and cloudy appearance. There is a reduced or altered meibomian gland secretion with increased evaporation of tears. The ducts are blocked; there is a thick, cloudy or granular secretion. Some clinicians suggest an infectious or inflammatory etiology while some also contend that MGD can be referred to as posterior blepharitis.

The altered secretion can be responsible for irritated, red eyes and reduced contact lens wearing time. The glands should be examined at each visit. Although contact lens wear cannot be considered a cause of MGD, many problems that relate to contact lens wear can be traced to problems in tear film function; it is in this regard that MGD can be of etiologic significance.

Patient Management of MGD

a. Warm Compresses:-The flow of secretion may be improved by the use of warm compresses to the closed eyelids. This procedure is used to melt solidified lipids, and thus

unblock the meibomian orifices to allow the lipids to escape and reconstitute the tear film layer.

b. Lid Scrubs/ Eyelid hygiene: - The maintenance of clean and healthy lid margins is likely to be of benefit by preventing additional debris from blocking the meibomian orifices, and lessening the possibility of of infection in the meibomian gland. Proper lid hygiene also lessens the likelihood of developing into a chalazion.

c. Mechanical expression: - Gentle pressure is usually all that is required to facilitate the expression of meibomian gland oils.

d. Antibiotics: - It is thought that sometimes systemic antibiotics such as tetracycline may act by killing bacteria that normally split neutral lipids into fatty acids.

e. Artificial tears: - Supplementing the tear film with artificial viscosity agents may help to increase tear volume, and so prolong the formation of a tear layer over the lens and ocular surface. This should provide at least symptomatic relief, and lessen the dryness sensation.

2. Staphylococcal blepharitis: - This is caused by staphylococcal infection of the bases of the bases of the lashes. It is associated with dry eyes. It causes itching and burning and is characterized by collarettes of hard scales surrounding the bases of the lashes. In severe cases, bacterial exotoxins enter the tear film, irritate the ocular surface, and can cause epitheliopathy with punctate staining.

3. Seborrheic blepharitis: - This affects the glands of Zeis and the skin of the scalp and face. The scales may be greasy or dry and the lashes are greasy and stuck together. It is less severe than the staphylococcal form.

D.Evaporative Dry eye

In this case the lacrimal function is normal, but evaporation of the tear film is greater than normal and the supply of fresh tear fluid does not meet the demand. It could be due to:

1. Oil deficient: - Absent glands, distichiasis.

2. Lid related-Blink abnormalities, aperture abnormalities, lid surface incongruities.

3. Contact lenses

4. Surface change-e.g. xerophthalmia

Chapter 4

I. TREATMENT/ RECOMMENDATIONS

Contact lens wearers who suffer from dry eye have an especially difficult experience. Contact lenses disrupt the normal pre-corneal tear film and promote tear loss and evaporation. Ocular dryness is the most common complication associated with soft contact lens wear. Approximately four out of five lens wearers report symptomatic dryness during some portion of their wearing schedule [1]. In spite of this, the highly motivated contact lens wearers continue to wear the contact lenses and suffer the countless problems related to this ocular dryness.

A lot of factors can cause or exacerbate dry eye; environmental conditions, smoking, diet, lid disease, lid anatomy, blink rate, medications, systemic disease, gender and age.

A. Treat ocular surface problems first: - Assess meibomian gland function, as healthy meibomian glands are necessary for a stable tear film. For some patients, without a stable and healthy tear film, wearing contact lenses definitely makes them get dry eye. Patients with lid disease, like blepharitis, must have that treated before treating the dry eye. Lid scrubs and warm compresses can be very helpful for these conditions.

B. Artificial Tears/ Rewetting drops: - The use of artificial tears and contact lens rewetting drops are often of benefit. Regular use of artificial tears/ rewetting drops provides better relief, especially the ones which are preservative-free. Ask the patient to decrease his/her wearing time and use these preservative free drops more often to improve their tear film. The preservatives found in some of these drops may contain toxins which may disrupt the

tear film; they can also bind to the contact lens surface and create an uneven surface over which tears will not flow smoothly [14].

C. Rehydrate the lenses: - All soft lens materials dehydrate in vivo, most likely through evaporation [1]. Therefore it is important to advice your patients to rehydrate their lenses frequently. Have them remove their lenses about halfway through the day or towards the end of the day if they have a long evening ahead and soak them in a case with fresh saline or a multipurpose solution for anywhere from 5-30 minutes. This regimen usually allows contact lens wearers with dry eye or people who have to wear their lenses for longer periods to extend their wearing time.

D. Suspect the solutions: - When simple rehydration with drops or soaking doesn't work, the dryness symptoms may not be due to the effects of evaporation. Contact lens care products might be a cause of contact lens intolerance and dry eye related symptoms. Lens care solutions can cause symptoms of dryness, and may sometimes cause corneal staining, and decreased contact lens wear time among others. Comfort at the end of the day has been associated with improved lens surface wetting, suggesting that differences exist in contact lens wettability for various storage solutions [1, 14]. The need to balance the microbial efficacy of these contact lens solutions, with patient comfort, ocular health is a big challenge today for the makers of these products. Even though the exact ingredients in all preserved contact lens solutions haven't been identified, some biguanide – preserved solutions have been associated with increased corneal staining, decreased contact lens wearing time and cessation of contact lens wear especially when used with certain lens materials including HEMA-based hydrogels, silicone hydrogels and GP polymers [1,14].

E. Prescribe Therapeutics: - Restasis (0.5% cyclosporine) is the first FDA approved therapeutic agent specifically indicated for the treatment of dry eye. It works by preventing the activation of T-cells and the production of inflammatory cytokines. A study by Milton Hom in 2006 suggests that numerous ocular surface conditions, including contact lens intolerance, may have an inflammatory component that is ameliorated with the use of cyclosporine [15]. Studies have also demonstrated that pre-lubrication of the ocular surface with a lubricant eye drop before applying a contact lens may increase the comfortable lens wearing time. The use of 0.5% cyclosporine A in contact lens patients before lens application and after lens removal can also significantly increase comfortable wearing time though studies in this area have been limited [16].

Oral Doxycycline is an antibiotic with anti-inflammatory action proven to be of benefit in the treatment of dry eye. It inhibits the formation of cytokines, such as interleukin-1 (IL-1), and damaging enzymes, such as matrix metalloproteinase-1 (MMP-1) and MMP-3 and may be beneficial in patients who fail to improve with lubricating drops and lid hygiene. In some cases especially if combined with corticosteroids [17]. Although designated as a tetracycline-class antibiotic it can be an effective therapy for non-infectious conditions involving the eye such as acne rosacea and meibomianitits as well as for chronic blepharitis. It has the ability to modify fatty acid metabolism within the meibomian glands and thus enhance the lipid layer of the tear film [14]. It is usually used and tapered for a long time in order to get the therapeutic effect.

F. Supplements: - Adding Omega-3 fatty acid supplementation (recommended dose ~ 2g/day) [13], especially in patients with severe dry eye, helps enhance the glandular secretions of the meibomian glands. This enhancement stabilizes the lipid layer and subsequently the entire pre-corneal tear film [14]. North Americans have a very low dietary intake of omega -3 acids. The two most common sources of Omega-3 fatty acids are fatty cold water fish and flax seed oil [18]. For some patients this may be important adjunct treatment. Increased intake of Omega 3 from food is ideal. Supplements are available in a variety of forms; softgel or liquid form (latter can be added to salads, shakes etc). A combination product of both oils is available as a soft gel tablet, Thera Tears Nutrition (Advanced Vision Research, Woburn, MA.). Other omega 3 supplements include Dry Vites (Deep blue See, New York, NY) and Tears again Hydrate (Ocusoft, Richmond, TX).

G. Silicone hydrogels: These may be an acceptable option for patients with contact lens related dry eye. The high oxygen transmissibility of the silicone hydrogel contact lenses results in greater compatibility with the human eye in terms of less hypoxic changes in the cornea over time, reduced limbal redness, less sensitivity to low tear volumes plus greater overall comfort. The silicone hydrogels are low water content, high permeability materials for which evaporation and dehydration appear to be significantly less of a problem than with conventional hydrogels [1]. Silicone hydrogels are also easier to handle, easier insertion and removal. They also have low protein deposition, therefore less preservative uptake. The silicone hydrogel materials offer patients longer wearing times and generally fewer overall clinical complications.

There are many causes of contact lens related dry eye. Trying to narrow down the potential cause of the patients symptoms and treatment of the patient may be tough, however when our patients are happy and comfortable with their contact lenses they are less likely to discontinue contact lens wear entirely, and will be great practice builder.

Chapter 5

CONCLUSION / SUMMARY

In 1993-1994, the National Eye Institute and key industry corporations sponsored workshops on dry eye syndrome. The 1995 report from these workshops indicated that contact lens related dry eye is a major sub-classification of dry eye syndrome [2, 19]. The epidemiology of contact-lens related dry eye is still poorly understood. Although we know as many as 50% of the 35 million contact lens wearers in the US have dry eye symptoms [2, 20]. One survey of practitioners in the US showed that 18-30% of soft contact lens wearers had symptoms of dry eye, 12-21% were symptomatic enough to reduce their contact lens wearing time and 6-9% could not wear contact lenses because of dryness symptoms [20, 21]. Suggesting that up to 17 million contact lens wearers in the US could suffer from symptoms of contact lens-related dry eye [21].

Contact lens discomfort is the number one reason patients discontinue contact lens wear altogether, and contact lens wearers who suffer from dry eye have a difficult experience, but the highly motivated contact lens wearers still wear their contact lenses and deal with all the problems related to dry eye. It is important to accurately classify contact lens related dry eye to be able to identify risk factors associated with this condition. Knowledge of these risk factors may allow clinicians to deal with issues of discomfort, ocular surface desiccation and disease, and ultimate failure of contact lens wear. Some of these risk factors are smoking, lid disease, medications, gender, age, prolonged reading or computer use to name a few.

Assessment of the patient's symptoms is a very important step in the diagnosis and treatment of dry eye [21]. There are many ocular symptoms associated with dry eye syndrome including ocular fatigue and discomfort, redness, itching, dryness, irritation, crusting of lids, scratchiness, epiphora, blurry vision, pain, photophobia, foreign body sensation and others not listed [21].Each of these vary in their frequency and severity depending on the cause of the dry eye.

A lot of research has gone into trying to find out the causes of dry eye syndrome, and its treatment. Especially considering the number of people afflicted with dry eye in the population and the number of people who discontinue contact lens wear due to contact lens related dry eye.

A thorough case history needs to be obtained from the patient in order to try to determine patients' exposure to certain risk factors which may be contributing to their dry eye and also in order to find out their symptoms and try to determine the etiology of the patients' specific dry eye. In order to do this, there have been several questionnaires developed by different researchers to try to determine patients with dry eye and those with contact lens-related dry eye. Some examples are the Contact Lens Dry Eye Questionnaire (CLDEQ), the McMonnies Questionnaire to name a few, and the Dry Eye Questionnaire (DEQ). This is a very important first step in determining those contact lens patients who suffer from dry eye before they discontinue contact lens wear. Especially because although 2.8 million new wearers enter the U.S. market each year, roughly as many existing wearers drop out, primarily because of issues with comfort [3].

Once the patient has been diagnosed with dry eye, it is very important to try to figure out the cause of the dry eye and deal with it. Some researchers have said that contact lens wear will be most successful in patients who have a normal tear film and lid function. They went further to say that patients with dry eye who wear contact lenses need to be recognized and identified before or during contact lens wear because they will need special instructions about the risks of intolerance and potential infection, and will also need instructions in the methods of improving meibomian gland function to enhance tear stability. The most tolerated and safest contact lenses will be those most compatible with the tear film, and that least disturbs normal tear film stability.

Dry eye and its effect on contact lens wearers will continue to be a very well researched area, hopefully one day there will be an easy answer to contact lens-related dry eye.

REFERENCES

1. Smythe J et al. Dry eye and contact lenses: A review of the causes, symptoms and cures. Optometric Management; March 2003.

2. Doughty, M.J et al. A Patient questionnaire approach to estimating the prevalence of dry eye symptoms in patients presenting to Optometric Practices across Canada.

3. Barr, J. "2004 Annual Report". Contact Lens Spectrum. January, 2005.

4. Farley D. Keeping an Eye on Contact Lenses: Safety, Options Shape Contact Lens Decisions. "U.S. Food and Drug Administration: FDA Consumer. March-April 1998; revised August 1998

5. National Consumer Affairs Center of Japan. NCAC News Vol. 12, No. 4. NCAC News. March, 2001

6. Goodlaw E. A personal perspective on the history of contact lenses. International Contact Lens Clinic 2000; 27(4):139-145

7. http://en.wikipedia.org/wiki/Contact_lens

8. Millis EAW. Medical contact lens practice. Elsevier Butterworth- Heinemann. 2005

9. Guillon M, et al. Dry Eye Symptomatology of Soft Contact Lens Wearers and Nonwearers Optometry and Vision Science: Volume 82(9) September 2005;pp 829-834

10. Begley C.G. et al. Responses of contact lens wearers to a dry eye survey. Optometry and Visual Science; 2001; 77: 40-6

11. Mannis, M. J, Smolin G. 1996. Natural defense mechanism of the ocular surface. Ocular infection and immunity. Mosby, St. Louis, Mo.

12. Behrens, A et al. Dysfunctional Tear Syndrome: A Delphi Approach to treatment recommendations. Cornea: September 2005 (25) pp 900-907.

13. Efron N. Contact lens complications. 2nd edition. Butterworth-Heinemann 2004.

14. Bowling EL. Contact lens-Related dry eye: Treatment tips for a common condition. Review of Optometry; September 15, 2007

15. Hom MM. Use of cyclosporine 0.05% ophthalmic emulsion for contact lens-intolerant patients. Eye contact lens. March, 2006; 32(2) 109-111.

16. Nichols KK, et al. The latest Research and Treatment options for Lens-Related Dry Eye. Contact lens Spectrum, September, 2006

17. Dursun D, et al. Treatment of recalcitrant recurrent corneal erosions with inhibitors of matrix metalloproteinase-9, doxycycline and corticosteroids. Am J Ophthalmol 2001 Jul; 132(1):8-13

18. http://www.hsph.harvard.edu/nutritionsource/Ask_the_Expert_Omega3.pdf

19. Foulks, G.N. What is dry eye and what does it mean to the contact lens wearer? Eye & Contact Lens: Science & Clinical Practice, Volume 29(1) Supplement 1.January 2003.S96-S100

20. Begley CG., et al. Characterization of ocular surface symptoms from optometric practices in North America. Cornea 2001; 20:610–8.

21. Nichols, J.J et al. The Performance of the Contact Lens Dry Eye Questionnaire as a Screening Survey for Contact Lens-related Dry Eye. Cornea 21(5): 469–475, 2002.