PSS NEWS

An On-Line Publication for COPE Continuing Education in Optometry

A Guide to Dry Eyes

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Learning Objectives:

1. **To review the basics of dry eye diseases**
2. **To discuss diagnostic techniques to properly diagnose dry eye disease**
3. **To learn about management options for patients suffering from dry eye disease**

Dry eye disease is one of the most prevalent health conditions that we'll manage in our offices. Current data estimates that the prevalence of dry eye ranges between 6.8% to 87.5% of the population based varying on amount of computer use, regional differences, sex, age, contact lens wear and medication use.[1-5] As we spend more time on computer screens, we increase the environmental demand on our ocular surface.[1,5]

The health of the ocular surface is critical in so many facets of eye care. It contributes to the clarity of vision and the comfort of our eyes. A compromised tear film reduces the quality of vision that a patient may experience. This is critically important for all patients, in particular for those that are updating glasses, wearing contact lenses, and those patients who are having refractive or cataract surgery. Additionally, ocular comfort is critical for normal functioning of the eye but critically important to optimize contact lens wear as contact lens discomfort is the number one reason that someone will discontinue contact lens wear.[6]

As such, both identifying and appropriately treating patients with dry eye is critical in order to optimize the health and well being of the ocular surface. We will review strategies to appropriately diagnose dry eye disease along with strategies to optimize clinical outcomes through appropriate treatment.

Diagnosis

Diagnosis is critical in the evaluation and management of any condition affecting the eyes. It is critical to understand and embrace the diagnostic tools that we have available to help us identify patients with dry eye. Additionally, with newer diagnostic tools, it helps us diagnose these patients sooner in the disease process which ultimately improves clinical outcomes. Ideally, when identified, the treatment plan should follow a comprehensive approach by treating the underlying cause of the clinical manifestations

of the condition ultimately leading to the best clinical outcomes. Here are the diagnostic tools along with clinic pearls for the tests.

History

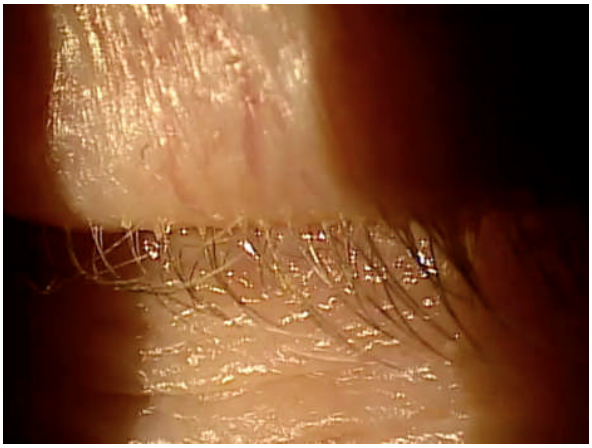
Patient history is critical with any condition that we manage. The variability of ocular symptoms that patients with dry eye disease can manifest are highly variable. A standardized dry eye disease questionnaire provides a way to objectively analyze the patient's symptoms. This will ultimately allow us to better judge either the success or failure of their treatment. There are several standardized dry eye disease questionnaires specifically for this purpose. There are over a dozen dry eye questionnaires available. Some are more common in research settings. Two that are commonly utilized in clinical settings are the Ocular Surface Disease Index (OSDI) and the Standard Patient Evaluation of Eye Dryness (SPEED) questionnaire.

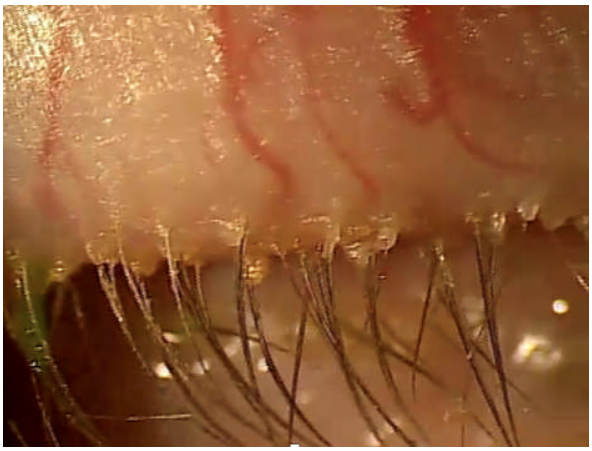
The OSDI has twelve questions and asks about ocular symptoms, vision related function and environmental triggers over the last week. A total possible score that can be obtained is 100. The higher the score, the more symptoms the patient has. A score of 12 or under represents a normal patient.[7,8] The SPEED questionnaire assess the frequency and severity and is a total of 8 questions. As with the OSDI, the higher the score, the more symptomatic the patient is. The highest score that can be obtained is 28 and a score of 8 or below is considered normal.[9]

Slit Lamp Evaluation

Although this is something that is performed on every patient at every exam, there are several strategies that can help uncover underlying risk factors for the dry eye symptoms a patient may present with. The lid margin has demonstrated itself to be one of the most important anatomical structures contributing to either a healthy or unhealthy ocular surface. As such it is critical to carefully examine the external surface of the lid margin, in particular the base of the lashes.

It is common to examine the external lid margin at a low magnification and perform a cursory look at the lid margin. By examining the lid margin at a high magnification, it may manifest disease that is difficult to appreciate at low magnification levels (Figure 1).





The base of the eyelashes can be truly telling as excessive bacterial populations can be easily seen when accumulation occurs. The dry eye blepharitis syndrome (DEBS) is a theory discusses bacterial causes as being the key etiological factor for the development of dry eye.[10] They describe the biofilm beginning on the external lid margin at the base of the lashes and then spreading posteriorly to the meibomian glands (MG), then to accessory lacrimal glands and ultimately to the primary lacrimal glands.[10.] It

is clearly important to identify excessive bacterial overpopulation at the base of the lashes in order to treat appropriately and prevent the potential downstream ramifications of the bacterial overgrowth.

Determining the cause of the overpopulation is critical as this will set the stage for appropriate treatment. Demodex over population needs to be identified and differentiated from bacterial over population at the base of the eye lashes. The appearance of the collarettes at the base of the lashes will give you clues as to whether it is a demodex overpopulation. These deposits tend to tightly bind to the base of the lashes and extend from the lash orifice. Removing lashes from their follicles and assessing them under a light microscope on a slide with a drop of oil at high magnification will allow the visualization of whether there is in fact a demodex overpopulation.[11-13]

Another important anatomical structure to pay particularly close attention to is regularity of the lid margin. We expect to see a smooth appearance to the upper and lower lid margin along the ocular surface. If there are irregularities seen, this triggers the clinician to look for explanations on why this may be occurring. The most common reason that this will be seen, other than frank injuries that have caused disfigurement in the lid margin, is the involution of the meibomian glands. This can easily be seen as an irregularity at the MG orifices leading to an irregular lid margin.[14]

Irregularities in the lid margin that can physically alter the dynamics of the manner that the tears spread over the ocular surface is the blink dynamics. It is clear that the blink reflex is altered depending on the environment that we are in. Computer use is a clear risk factor that alters the blink and leading to reduced blink rate and incomplete blinks.[15] Lagophthalmos is another important risk factor to be sure to rule out as a reason for ocular surface issues.[16] As such, careful assessment of the blink is critical.

Lid laxity is another important finding to identify. Actively pulling the lower margin away from the ocular surface and attempting to evert the upper lid will give you insights into the lid elasticity. With normal lid dynamics, we expect a firm amount of elasticity to pull the lid margin back to the ocular surface when pulling the lid away is attempted. Reduced lid elasticity can alter the dynamics of the ocular surface and in the most extreme situations, can cause floppy eyelid syndrome(FES).[17] FES can lead to spontaneous lid eversion in the evening while patients are sleeping leading to symptoms of dry eye caused by altered lid dynamics.

Meibomian Gland Assessment

Meibomian glands (MG) are critical in their influence on the tear film and ocular surface. There are two key components to assessing the meibomian glands with the current technologies we have available: function and structure.

Function of the meibomian glands is measured through gentle pressure being applied to the lid margin and assessing the quality of the meibum that secretes from the meibomian gland orifices along the upper and lower lid margins. This can be done in several ways including gentle finger pressure, pressure with a cotton tip applicator or with a mastrota paddle. There is a controlled way to provide 1.25g/mm^2 of pressure through the use of a meibomian gland evaluator (MGE).[19] This is a clinical tool that provides a consistent amount of pressure along the lid margin. The MGE can be used to assess the meibomian gland yielding liquid secretions (MGYLS). Reduced MGYLS is diagnostic for MGD and has been shown to be associated with dry eye symptoms.[20]

Just as important as the function of the MG's is the structure of the MG's. The MG structure can be viewed in several ways. By simply pulling down the lower lid and viewing the palpebral conjunctival surface, you can

often times obtain a gross anatomy of the meibomian glands (figure). At the slit lamp, eyelid transillumination can easily be performed. In this technique, the lower lid is pulled down at the slit lamp using a transilluminator and the light is shone through the lower lid.[21] The light will not be allowed to shine through the regions where the glands are located and will look darker than surrounding tissue around the gland. This allows you to view whether there is any MG's that are truncated or have dropped out.

The most advanced way to visualize the meibomian glands is the through infrared (IR) imaging. IR imaging leverages the fact that the meibomian glands are more metabolically active than the surrounding tissues allowing it's visualization. This provides critical clinical information help to understand the structure of the glands in order to help best plan an appropriate treatment. A standardized meiboscale provides a scaling system that describes the area of loss of the MG. There are five degrees of MG loss: 0 (no loss), 1 (<26%), 2 (26%-50%), 3 (51%-75%) and 4 (>75%).[23] A large proportion of patients with dry eye have MG dropout indicating its important role in dry eye disease.[24]

Vital Dyes

Vital dyes are critical to help assess for signs of ocular surface compromise and also to help us monitor the success or failure of treatment approaches for dry eye disease. Vital dyes help us identify dry by demonstrating the effects of dry eye on the ocular surface. Dyes show us the specific tissues that may have been compromised from ocular surface disease and provides objective findings to monitor for improvement in the way the ocular surface functions.

Fluorescein (FL) allows for the visualization of the ocular surface in a unique way and is optimized with a cobalt blue light and a #12 wratten filter. Fluorescein is a dye that is hydrophilic and diffuses into the tear film allowing the opportunity to assess the tear film with it. Tear film break up time is the time from the blink to the first dark region formed in the tear film with FL on the eye. The expected normal range is 10 seconds before a dry spot forms and anything less is considered abnormal, between 5 and 10 seconds is a marginal tear film and below 5 seconds is indicative of dry eye.[25]

Lissamine green (LG) and rose Bengal are two other types of dyes that can be used. These both stain dead or devitalized cells. Lissamine green has largely replaced the use of rose bengal as it usually does not cause the stinging sensation that sometimes rose Bengal can and it is much less aggressive looking if it is on the skin of the lids. It is important to note that after being placed on the eyes, LG is seen best when the illumination is low or if there is a diffuser placed over the slit beam.

Fluorescein and LG stain will both stain the cornea and conjunctiva if the ocular surface is compromised secondary to dry eye. FL will pool in intercellular defects,[26] whereas LG will stain dead or devitalized cells.[27] Often times they will both stain similar areas, but sometimes you will see staining with one and not the other. The most thorough assessment of the ocular surface involves utilizing both stains.

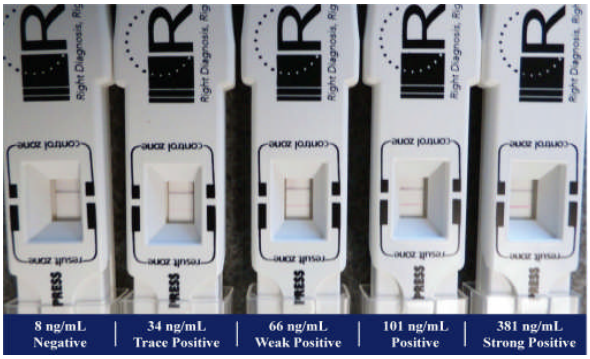
Another important marker is the presence of lid wiper epitheliopathy (LWE). The Lid wiper area (LWA) is the tissue on the superior and inferior lid margin just posterior to the line of Marx (LOM). When the LWA becomes irritated and inflamed secondary to excessive levels of friction and absorbs vital dyes, it is referred to as LWE. If present, LWE can be seen after the instillation of FL and/or LG as a band of staining in the LWA.[28] The line of marx (LOM) is the anterior margin of the LWA and can be seen as a line that stains with both FL and LG. It is the separation of the keratinized epithelium of the anterior lid margin and the mucous epithelium of the posterior lid margin, commonly referred

to as the mucocutaneous junction of the lid margin. The LOM will migrate anteriorly and will also become less regular in the presence of meibomian gland dysfunction.[29]

Point of Care Tests

Inflammation can currently be measured utilizing the Inflammadry by quidel. This test is intended to be used on each eye and measures for elevated levels of matrix metalloproteinase-9 (MMP-9).[30, 31] The inflammadry test has a sensitivity level of MMP-9 greater than 40ng/mL on the ocular surface. The test should be performed by a skilled technician as the test is highly dependent on the volume of tears that are sampled.[32] It should be noted that the test is specific for MMP-9 levels which is a non-specific inflammatory marker that is known to be elevated in patients with dry eye.[30,31] It will not measure for other inflammatory mediators that may be elevated in patients with dry eye.

The inflammadry test is sensitive for levels of MMP-9 concentrations of greater than 40ng/mL. Interestingly, the signal strength is more intense as the concentration of MMP-9 is increased in the tear film. Drs. Brujic and Kading presented a grading scale on measuring signal strength as an opportunity to understand inflammation over time in the dry eye patient and to determine the influence of treatment on inflammation levels.[33] The scale has five categories from no detectable inflammation to the strongest levels of inflammation.



The levels of inflammation are categorized as: negative, trace positive, weak positive, positive and strong positive. Examples of the inflammation levels can be seen in figure 2.

Another point of care test is tear film osmolarity. The literature is clear that tear film osmolarity increases in dry eye patients. Tear osmolarity values can vary and have been shown to be 302+/−8 mOsm/L, 315+/−10 mOsm/L and 336+/022 mOsm/L, for normal, mild/moderate, and severe dry eye patients.[34,35] Additionally, in a normal individual, we would expect to see a very symmetrical osmolarity reading between the right and the left eye. As with other conditions in eyecare, although dry eye is a bilateral condition, it is can present asymmetrically in either the signs and/or the symptoms a patient presents with. Asymmetrical osmolarity levels should increase suspicion of dry eye.[34] Osmolarity provides a good opportunity at the time of diagnosis and also to monitor success versus failure of treatment efforts.

The diagnostic to tools that we have access to provide us with the ability to more accurately identify the underlying cause of the signs and symptoms that the patient is experiencing. With advancements in treatment, it is critical to incorporate all of the information acquired diagnostically to optimizing the treatment plan.

Treatment

Once appropriate diagnostic information has been obtained, an appropriate treatment plan should be put in place for patients. There are really two goals with treatment: 1) improve comfort of symptoms and 2) improving ocular surface function. Interestingly, as we improve the function of the ocular surface, we will improve the comfort and other symptoms such as visual instability that a patient may experience. With this treatment approach in place, the dry eye management plan becomes

much more focused and targeted to optimize outcomes.

Artificial tears have become increasingly intelligent with respect to their ingredients and how they are engineered to optimize their performance on the ocular surface. Several demulcents are well established and used in artificial tears to increase the volume of the tear film including carboxymethyl cellulose, polyethylene glycol and propylene glycol. Other contemporary ingredients such as sodium hyaluronate, trehalose and hydroxypropyl guar increase tear retention on the ocular surface.[36-38] Artificial tears containing these substances provide excellent supplementation for a tear film that is compromised from changes in environmental risk factors such as the person who periodically needs moisture when on a plane or periodic dryness while on the computer.

Additional advancements in artificial tears allow practitioners to become much more targeted in terms of the conditions that they are utilized for. Lipid containing artificial tears have become increasingly utilized for those patients who have MGD as a way to supplement the lipid layer that may be being produced insufficiently.[39, 40] Targeted artificial tear technology allows practitioners to be much more intentional with their tear supplementation treatment efforts.

Start Treating at the Front

External lid margin disease is one of the leading contributors to dry eye disease. We have often times encountered patients who have had active dry eye symptoms and either utilizing artificial and/or using prescription eye drops in an attempt to alleviate symptoms without amelioration. Once the anterior blepharitis is treated and managed, often times these patients dry eye symptoms improve.

Antibiotic drops are highly effective at reducing the bacterial overpopulation on the lid margin. Antibiotic and steroid combination drops provide the benefit of not only reducing the bacterial population but simultaneously reducing lid margin inflammation. Either of these strategies are often utilized initially to improve signs and symptoms and then managed with other long term lid margin hygiene strategies. An appropriate strategy, and one I personally guide my patients to do, is to place a drop on the ocular surface, then rub the additional drop into the lid margin with a clean finger.

There have been tremendous advancements in drug delivery systems in order to provide more targeted penetration in the ocular tissues that need the medication. Xanthum gum is currently utilized in a contemporary antibiotic/steroid combination to provide more intelligent introduction of medication to the ocular tissues that benefit from the medication contained.[41]

If the blepharitis is secondary to demodex overpopulation, the introduction of tea tree oil to the lid margin will help reduce concentration of the mite.[42] It is critical for patients to regularly utilize this to control excessive demodex populations along the lid margins.

Long term maintenance of lid marign health often times requires regular lid hygiene. There are several commercially available lid scrubs that provide patients a convenient way to keep the lid margins healthy. There are also commercially available formulations of hypochlorous acid that provides patients a convenient means of providing lid margin health and hygiene. Hypochlorous acid is a naturally produced substance produced by neutrophils. It has both anti-inflammatory and anti-infective properties. These properties make these formulations a realistic option for a number of patients with blepharitis.[43]

Microblepharoexfoliation is also an effective way to reduce lid margin populations of bacteria and demodex. This is a procedure that is performed in the office. Proparacaine

is placed in the eye and then the upper and lower lid margins are mechanically debrided using a mirco-grade surgical sponge that rotates after being soaked in a soap formula. This mechanically removes deposits at the lid margin. Additionally, active debridement can occur posterior to the lash marign along the meibomian gland orifices. A single microblepharoexfoliation has demonstrated a reduction of ocular surface inflammation, improved tear film characteristics, improved corneal staining and improvement in contact lens comfort.[44,45]

Meibomian glands

Over the last two decades, the influence of the MG's has become an increasingly important in our understanding of dry eye disease. The MG's produce meibum which forms the lipid layer of the tear film. As such, it is critical to have free flowing meibum for a sufficient lipid layer and appropriate ocular surface health.

There are treatments that provide opportunities to help these individuals. The etiology of MGD is an elevated melting point of the meibum that is in the gland producing obstruction of the gland.[46] Initial therapy for these patients includes warm compresses along the lid margin in attempts to melt the meibum and allow appropriate production of more fluid meibum from the glands. Fortunately there are several commercially available warm compresses that can be conveniently used by patients.

In office procedures have advanced tremendously providing patients additional options. Lipiflow is a thermal vectored procedure that provides heat along the posterior surface of the lid along the palpebral conjunctiva while simultaneously providing gentle pulsating pressure along the external surface of the eyelid. One lipiflow treatment has demonstrate an increase in MGYLS, tear film break up time (TBUT) improved symptoms and an increase in comfortable contact lens wearing time.[47-49]

A hand held treatment device, iLux, provides the clinician a handheld treatment approach for MGD. This device applies heat to the external lid while simultaneously providing pressure along the external lid surface. This is all performed while the clinician views the lid margin through a magnifying lens on the device. This allows visualization of meibum from the MG's as it is being expressed. A single treatment has shown significant improvements in MGYLS, TBUT and symptoms.[47]

TearCare is the newest procedure in this category of MG treatment.[50] In this procedure, smart lids are placed on the external surface of the upper and lower lids and heats the lids for 15 minutes at 45^{o}C. After the 15 minutes of thermal application, the meibomian glands are expressed with a specialized forcep referred to as the clearance assistant. This procedure has demonstrated an improvement in MGYLS, TBUT, conreal staining, conjunctival staining and dry eye symptoms.[50,51]

It is noteworthy that the structure, including the length and presence or absence of the meibomian glands is critical to understand in these patients. For the latter two procedures described, it will help guide the clinician to apply more focused evacuation of the glands where the glands are still present. Additionally, it will help in assessing functionality of MGYLS both before and after treatment. Understanding the meibomian gland structure helps describe expected clinical outcomes of treatment in a more accurate way. I am much more optimistic of clinical outcomes of a patient with MGD of an individual with MG that are not truncated. I am much more guarded in the description of clinical outcomes when the patient has significant truncation or dropout of the MG's.

Reduce Inflammation

Inflammation is a key component to dry eye disease. Decreasing inflammation if elevated is of paramount concern. As such, it is critical to understand inflammation and also how to alter it. There are several opportunities to reduce inflammation.

Nutrition has been long known to influence inflammation in the body. We understand that several nutritional compounds have been shown to reduce inflammation. Essential fatty acids have demonstrated a reduction in ocular surface inflammation and have been shown to improve dry eye symptoms.[52,53] There is some research has challenged it's ability to improve dry eye symptoms.[54] Most clinicians still recommend essential fatty acids for dry eye.

There are a number of pharmaceuticals that are available that have shown to reduce inflammation. Cyclosporine 0.05% (Restasis) is an immunomodulatory molecule that is approved as a bid dosing regimen and FDA approved to increase tear production in those with dry eye.[55-57] Lifitegrast 5% (Xiidra) is a lymphocyte functioning antigen-1 antagonist. It inhibits LFA-1 interaction with ICAM-1 and reduces inflammation on the ocular surface.[58,59] It is approved as a bid dosing regimen. Cyclosporine 0.09% (Cequa) is an immunomodulator and is FDA approved for a bid dosing regimen.[60] Unique to this pharmaceutical is a unique nanomicellular delivery mechanism of the cyclosporine into the target tissue providing greater tissue penetration.

Topical corticosteroids have been used to reduce inflammation in patients with dry eye for decades in an off label manner. Topical corticosteroids reduce inflammatory levels on the ocular surface allowing for a rapid improvement in the signs and symptoms of dry eye.[61,62] Corticosteroids can cause an increase in intraocular pressure and over long periods of time can cause the formation of posterior subcapsular cataracts. As such, corticosteroids are often times pulsed and used for short periods of time to manage dry eye signs and symptoms.

Recently loteprednol etabonate 0.25% (Eysuvis) formulation was approved to treat the signs and symptoms of dry eye. It is approved to be used four times a day for up to two weeks. Eysuvis has an intelligent delivery system that more efficiently delivers the molecule to the target tissues.[63,64] This technology seems to be intelligently designed for dry eye flares of dry eye signs and symptoms.

Retaining Tears

Improving the quality of the tear film components along with the volume of tears while reducing inflammation is critical for successfully managing patients with dry eye. Just as important as these strategies are, it is critical to understand when to appropriately retain tears on the surface of the eyes through punctal occlusion.[65-67]

Leveraging technologies to help determine this is critical. Certainly, any frank blepharitis that is untreated would be a contraindication for punctal occlusion. Additionally, be cautious with the use of punctal plugs in the presence of visible conjunctival hyperemia. Also, the use of the inflammadry point of care test will allow for the objective measurement of inflammation on the surface of the eyes. Be cautious and consider a negative inflammadry test before pursuing punctal occlusion.

There are various types of punctal plugs. Silicone plugs are permanent plugs that are visible when placed in the puncta. The benefit to these plugs is that they are visible when placed appropriately. The potential disadvantages is that at times the plugs can cause irritation and plug awareness along the bulbar conjunctiva. Additionally, there is visible biofilms that can form along surface of these plugs and can cause irritation to the eye.

Dissolvable intracanalicular plugs provide opportunities to retain tears on the ocular surface without the awareness of the plugs. These are dissolvable plugs. The short term plugs are made of collagen and take about 7 to 10 days to dissolvable. Often times these are used to determine if longer lasting dissolvable intracanalicular plugs are indicated and also to determine the appropriate size of longer lasting plugs. Longer lasting plugs last between 3 to 6 months before dissolving and often times needing to be replaced with new plugs. We monitor these patients with inflammadry to confirm that they have low inflammation levels.

Rehabilitate the ocular surface

In more severe cases, often times more extreme measures are required. One of the strategies to help rehabilitate the cornea is a bandage contact lens. At times soft contact lenses can be utilized for this purpose.[68] Scleral lenses also provide an option for these patients by providing a moisture chamber that is retained on the cornea through the post lens tear chamber.[69-70]

At times, amniotic membranes may be indicated. Amniotic membranes provide the ocular surface a variety of cells and molecules naturally found in amniotic tissue that allows for rehabilitation of the compromised ocular surface.[71] There is currently an eye drop that contains the active molecules from the amniotic tissue that can be used in lieu of the membrane for some patients.[72]

For those patients that simply need additional moisture, ointment in the evening can help. Consider lacriserts for those patients who need the maximum moisture on the surface of the eye and are unable to continuously utilize artificial tears.[73,74]

Treatment efforts can be maximized by always considering the two major goals: 1) improve comfort and symptoms and 2) Improving ocular surface function. By leveraging the technologies that are currently available you will be certain to optimize the ocular surface health of your dry eye patients.

Conclusion

Dry eye can have a significant impact on the health of the ocular surface and a patient's quality of life. Understanding the diagnostic tools and appropriate treatments can help optimize an effective treatment plan for your dry eye patients and ultimately improve their ocular surface health and quality of life.

CONTINUING EDUCATION QUIZ

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Once you have registered for the course, you will be given an access code and go to www.flexiquiz.com where you will take the quiz. To earn credit, you must receive a grade of 70% or greater.

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Continuing Education Quiz

Questions

- The prevalence of dry eye ranges from 6.8% to _____ depending on the population being studied.
    - 21%
    - 38%
    - 78.5%
    - 87.5%

- Which of the following is an acronym for a dry eye questionnaire?
    - OHTS
    - SPEED
    - MGD
    - SPK

- What level of magnification does Dr. Brujic recommend for looking at the lid margin?
    - Low
    - Medium
    - High
    - Any magnification is fine

- According to DEBS, where does the biofilm on the ocular surface start?
    - Eye lash follicles
    - Meibomian glands
    - Lacrimal gland
    - Accessory lacrimal glands

- Which of the following is true of computer use?
    - It increases blink rate
    - It decreases blink rate
    - It fosters complete blinks
    - May cause glaucoma

- Floppy eyelid syndrome
    - Can cause spontaneous eversion of the lid in the evening
    - Is higher than normal elasticity in the lid
    - Is more often seen in individuals with low BMI
    - All of the above

- What pressure does the meibomian gland evaluator place on the lids?
    - 1.25 g/mm^2
    - 2.25 g/mm^2
    - 3.25 g/mm^2
    - 4.25 g/mm^2

- Which of the following describe a technique to evaluate the meibomian gland structure?
    - Infrared fundus photo
    - Autofluorescence
    - Eyelid transillumination
    - Meibomian gland evaluator

- Which of the following describes the most meibomian gland loss?
    - Grade 1
    - Grade 2
    - Grade 3
    - Grade 4

- Visualization of fluorescein is enhanced by:
    - Cobalt blue light and a wratten #12 filter
    - Only a cobalt blue light
    - Only a wratten filter
    - Utilizing the green filter

- Lissamine green stains
    - Intercellular spaces
    - Intracellular portions of healthy cells
    - Dead cells
    - Healthy cells

- Which of the following describes staining of the upper lid margin on the palpebral surface?
    - LWA
    - LWE
    - LOM
    - LG

- The inflammadry test has a sensitivity level of MMP-9 greater than ____ng/mL.
    - 4
    - 40

    - 400
    - 4000

- Which of the following most likely represents normal tear osmolarity findings?
    - 302 mOsm/L
    - 315 mOsm/L
    - 336 mOsm/L
    - 346 mOsm/L

- Which of the following is not a commonly utilized demulcent in artificial tears?
    - carboxymethyl cellulose
    - polyethylene glycol
    - propylene glycol
    - borate

- Which of the following is an effective way to treat demodex?
    - Antibiotics
    - Antibiotic/steroid combination drop
    - Tea tree oil
    - Hypochlorous acid

- Which of the following is an in office procedure to treat meibomian gland dysfunction?
    - Blephex
    - Tea tree oil
    - TearCare
    - Punctal occlusion

- Which of the following is a lymphocyte functioning antigen-1 antagonist?
    - Lifitegrast
    - Cyclosporine
    - Loteprednol etabonate
    - Olopatadine

- What concentration of loteprednol etabonate was recently approved to treat the signs and symptoms of dry eye?
    - 0.2%
    - 0.25%
    - 0.5%
    - 1%

- Which of the following creates a moisture chamber for the cornea?
    - Bandage contact lens
    - Scleral lens
    - Amniotic membrane
    - Punctal plug