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Dry Eye is a Disorder which Commonly Occurs in People Over the Age of 50

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Abstract

Dry eye is a condition in which there is a decrease in the secretion of tears or a decrease in their quality. Tears form a smooth surface of the eye that has a large share in achieving visual acuity, ensures the passage of oxygen to the cornea and moisturizes the surface of the cornea and conjunctiva. The result of these changes is insufficient eye moisture. Tears are important for overall eye and vision health. Every time when a person blinks, a layer of tears spreads like a protective film on the front of the eye. If it does not blink often enough, dry areas can form on the surface of the eye, which can lead to a decrease in visual acuity. Although dry eye syndrome can occur at any age, the risk is still higher in people over the age of 50, especially in women, which is associated with hormonal changes.

Keywords: *Eye, Dry Eye, LASIK, SMILE, Health*

Introduction

Dry eye is a multifactorial disease and there may not always be an agreement between symptoms (the patients' complaints) and clinical signs, such as tear production determined with the Schirmer's test [1]. The reasons for these discordances are complex. In cases where corneal neuropathy is deteriorating, the patient's symptoms may actually improve. In such a scenario, the patient's symptoms alone may not be sufficient for monitoring the effects of the given treatment. Here, objective imaging of the corneal epitheliopathy is vital and enables the clinician to advise the patient on whether the corneal epithelial damage has improved (reduced staining) or worsened (increased staining).

Imaging of corneal staining is not without obstacles. First, some nasal corneal fluorescein dye staining may occur in asymptomatic subjects, but this is not necessarily a sign of dry eye. Second, many symptomatic dry eye patients (categorized as level 1 disease in the dry eye workshop classification) may present without any corneal staining, suggesting that staining may be more valuable for the monitoring of severity rather than detection of mild dry eye.

Although clinicians are often able to visualize minute amounts of corneal epithelial staining using the slit-lamp microscope with high-power binocular eyepiece objective lenses, very often these details escape proper documentation by digital imaging. This may be due to the difficulty in finding the optimal focusing point of the instrument, lack of sufficient resolution or sensitivity of the charge-coupled device (CCD) chip. Sometimes poor imaging quality may also be a consequence of insufficient communication between the clinician who manages the patient and the ophthalmic imaging technician tasked to acquire the images

Syndrome

Dry eye syndrome typically feels better in the morning and it does not cause sharp, acute pain [2]. If examine the patient for lagophthalmos (eyes still partially open after closing gently), which can cause pain in the morning, but the exposure keratopathy of lagophthalmos usually does not cause severe, sharp pain. This scenario above would be most consistent with recurrent corneal erosions. Most commonly, a patient notes a history of corneal abrasion with a sharp object such as a paper cut or a fingernail. The abrasion elevates a layer of the corneal epithelium, which does not cement itself back down well. When patients sleep, the eyelid dries to and sticks to the corneal epithelium slightly. When the patient opens their eye, the eyelid pulls that unstable epithelium off—hence the severe eye pain.

The first line of therapy for preventing erosions is an over-the-counter lubricant eye ointment placed in the eye(s) before going to sleep. This prevents the eyelid from sticking to the epithelium. One could consider a bandage contact lens as a protective barrier. If these do not help, then one could denude the faulty epithelium. Other alternatives include lasering the epithelium and basement membrane

(phototherapeutic keratectomy) or stromal micropuncture (using a 25-gauge needle to scar the epithelium down).

Symptoms

Dry eye disease (DED) or keratoconjunctivitis sicca (KCS) is a multifactorial ocular condition resulting from tear film instability that can eventually lead to ocular surface damage [3]. Typical symptoms of DED include ocular discomfort, visual disturbance, itching, burning, sensation of foreign body, light sensitivity; inflammation and pain. Factors contributing to DED are insufficient tear secretion; excessive evaporation and alteration in the composition of the tear film. The tear film has three essential components: aqueous layer, secreted by the lachrymal glands; mucus layer, produced by the globet cells of the conjunctiva and by epithelial cells of the cornea and conjunctiva and finally a lipid layer, secreted by the meibomian glands. Changes in the tear film can be temporary causing an acute form of DED or long-lasting leading to chronic DED; damage to the ocular surface is usually more severe in the chronic forms than in the acute ones. DED is frequent in some conditions such as Sjögren's disease, or lachrymal gland dysfunction, but it can also be caused by vitamin deficiency, contact lens wear and use of several prescription drugs. As such, it is not surprising that DED is a very frequent condition; the prevalence varies tremendously depending on the study, and the condition is more frequent in patients with autoimmune diseases, postmenopausal women and elderly population.

The mild pain and aching quality sound most consistent with dry eye syndrome (DES) [2]. It is important to note that DES is the most common cause of eye pain! Most patients with dry eye-related pain describe generally mild, aching, pressure, or pulling sensation. Some say it radiates behind the eye and others say eye movement worsens it. It would be highly unusual for DES to cause sharp, stabbing or pounding pain or for it to be severe. Many patients note that the pain seems to wax and wane with the day. When patients wake up, their corneas have been protected all night and then become painful with exposure to wind and evaporation especially with reading. Interestingly, sometimes DES pain is unilateral. Many patients will note other symptoms of DES such as burning, blurry vision, tearing, redness, and foreign body sensation but not all will. Examination may show punctate epithelial erosions, early tear break up time (TBUT), blepharitis, or abnormal Schirmer's tear testing. In other cases, the slit lamp examination can appear quite unremarkable. In many, a topical anesthetic will greatly improve the pain. However, patients with chronic DES-related eye pain of several months duration may not enjoy improvement. This occurs because of upregulation of pain modulating proteins within the cornea. Looking at her medications, she is on two diuretics, a beta blocker and a SSRI, which may worsen DES.

Lachrymal Gland

The lachrymal gland is an appendage of the ocular surface that secretes tear fluid consisting of water, proteins, and electrolytes, which helps to maintain the cells of the ocular surface [4]. The lachrymal gland and ocular surface form a mucosal immune system, and both are affected by environmental factors. The quality and quantity of tear fluid decreases with age, and dry eye is one of most common problems in elderly patients visiting ophthalmologists. The lachrymal gland is innervated by the autonomic nervous system and the secretory function is very complicated. Few previous studies have examined the aging mechanisms of the lachrymal gland. Histopathological studies of the human lachrymal gland have demonstrated that acinar atrophy, periacinar fibrosis, and periductal fibrosis increase with age. Animal studies have shown that morphological changes, reduced lachrymal secretion of protein, decreased density of innervation, and increased number of inflammatory cells in the lachrymal glands occur with aging. Generally, inflammation and neural dysfunction might be involved in the pathogenesis of agerelated lachrymal gland dysfunction, but the mechanisms linking lachrymal gland dysfunction with aging remain unclear.

LASIK

LASIK (laser in situ keratomileusis) arose in the 1990s and combined photoablation using the excimer laser with a lamellar cut to create a hinged corneal flap aimed at preserving the integrity of the central anterior cornea including an intact epithelium [5]. The procedure involved use of the microkeratome to cut through the central cornea creating a corneal flap approximately 120–180 microns thick and 8–10 mm in diameter. The flap was lifted to expose the underlying stroma for ablation with the laser to achieve the desired change of shape and the flap was repositioned without sutures. The popularity of this laser-based refractive procedure is related to the perceived advantages for the patient – including rapid visual rehabilitation, reduced post-operative discomfort and a reduced wound-healing scenario that is likely to provide a more stable outcome. Problems with LASIK are associated with the creation of a hinged flap in the anterior one-third of the cornea and include dry eye, glare, epithelial ingrowth, corneal haze and diffuse lamellar keratitis. LASIK-associated dry eye is the most commonly reported problem affecting approximately 50% to 95% of LASIK patients. The fact that not all LASIK patients suffer from dry eye is curious and may be related to factors such as the size and thickness of the corneal flap, the depth of ablation with the laser, underlying sub-clinical conditions and/or the questions asked in surveys. Dry eye symptoms are caused by a combination of transection of corneal nerve axons with the microkeratome changing the function of the lacrimal gland–ocular surface unit and an altered distribution of the tear film due to the changed corneal curvature. Inflammation caused by LASIK may also contribute to dry eye and would explain the reported efficacy of treatment with topical anti-inflammatory drugs such as cyclosporine A for up to 6 months after surgery. This timing correlates with studies that showed that the return of corneal sensation, substantially diminished immediately after LASIK, was restored over the 6–12 months that it took the sub-epithelial and sub-basal nerve plexus to regrow. However, some

studies report that the total length and morphology of nerve fibres after LASIK is never completely restored to preoperative levels. Confocal microscopy of post-LASIK corneas out to 12 months has revealed decreased keratocyte numbers on both sides of the lamellar cut, increased numbers of activated keratocytes compared with PRK (photorefractive keratectomy) and undulations in Bowman's layer. Histology of post-LASIK corneal tissue has shown incomplete stromal wound healing and scar formation months to years after procedures. Issues with flap thickness related to the difficulties of cutting of the cornea with a mechanical microkeratome underlie many of the problems observed with LASIK. Additionally, biomechanical issues are of concern with LASIK (and PRK) procedures, as chronic interlamellar and interfibrillar slippage akin to keratoconus may result in biomechanical failure and ectasia.

LASIK Flap

Most frequent application of femtosecond laser in corneal refractive surgery is for corneal flap creation [6]. While creating the flap, each pulse of femtosecond laser generates microplasma at the focal point which leads to microscopic gas bubble formation and it dissipates into the surrounding tissue. Many of the pulses when applied one against the other in a raster pattern create a lamella by formation of a cleavage plane. This is followed by creating vertical side cuts by applying pulses in a peripheral circular pattern, thereby creating a LASIK flap. The flap can then be lifted for excimer laser ablation. Recently introduced higher laser firing speeds (e.g., IntraLase FS 150, WaveLight FS200, and VisuMax 500) have reduced the energy requirements, thus reducing the cavitation bubble size and duration, tissue inflammation, time of flap creation, and ease of flap lifting.

While comparing the flaps created by femtosecond laser and mechanical keratomes, femto-flaps show lower incidence of flap complications like buttonholing, irregular flaps, short flaps, or epithelial erosions. Also, femto-flaps give surgeons more choices for deciding flap diameters, thickness, hinge position, hinge length, side-cut angles, and capability of cutting thinner flaps to accommodate thin corneas and high refractive errors. Femtosecond laser created flaps characteristically have a planar architecture, which is responsible for uniformity of flap thickness and creates a strong flap adherence. A uniform bed further decides the predictability of the ablation, as the proper corneal depth affects the stromal hydration and ultraviolet absorbance during photoablation. Few other advantages of femtoflap include stronger flap adherence and therefore less influence by trauma, fewer induced higher order aberrations, better contrast sensitivity, lesser need for retreatment, lesser rate of epithelial ingrowth, and lesser incidence of dry eye. Visual and refractive outcomes of femtosecond laser-assisted LASIK demonstrate excellent safety and efficacy, with most studies reporting equivalence with microkeratome LASIK. With the current acceptance and future promise of femtosecond lasers, it will probably be the dominant technology used globally for flap creation in LASIK.

SMILE

Small Incision Lenticule Extraction (SMILE) is an all-femtosecond laser flapless procedure—it involves the creation of a lenticule after which a dissector is passed through a small incision to mobilize the lenticule and allow its removal [7]. It is approved to treat myopic sphere up to −10.00D, cylinder up to −5.00D and spherical equivalent up to −12.50D. This procedure came about as a result of the improvement in precision and technical design of the femtosecond laser such that the creation of lenticules of adequate dimension have been made possible. SMILE is a keyhole or flapless procedure, thus it has a reduced risk of traumatic cap or flap dislocation—albeit it may be more surgically demanding and require a higher learning curve.

There is less disruption of the anterior stromal nerve plexus leading to faster dry eye recovery. Preservation of the anterior stromal lamellar, and avoidance of vertical cuts contribute to better corneal biomechanics—and less propensity to develop corneal ectasia. Reports of outcomes for SMILE showed good results—with a high percentage of eyes with good UDVA (uncorrected distance visual acuity) and CDVA and within ±1.00D or ± 0.50D of intended correction, regular corneal topography, no induced spherical aberration, and good patient satisfaction. Several studies have reported no significant differences in post-operative UDVA and CDVA, nor in post-operative refraction between SMILE and LASIK. Higher refractive correction in the corneal periphery was achieved with SMILE rather than with LASIK, which has been postulated to explain lower values of spherical, coma, and total HOA's with SMILE.

One disadvantage of SMILE, compared to LASIK, is its slightly slower visual recovery. Lenticule dissection and extraction is the most challenging step and intra-operative complications associated with SMILE include epithelial abrasions, incision tears, difficult lenticule extraction, cap perforation, and suction loss. These complications were not significantly associated with visual or refractive sequelae. Post-operative complications include trace haze, some epithelial dryness, interface inflammation, retained lenticular fragments, and epithelial ingrowth. In spite of the current limitations for SMILE in terms of its treatment range, it has plenty of potential uses in the future all of which are being currently investigated– including the treatment of a higher range of myopia and hyperopia, as well as the transplantation of the preserved SMILE lenticule.

Tear Film

The tear film has not been included or discussed in any acknowledged schematic eye models [8]. Although the typical tear film is very thin (3–40μm) compared to the corneal thickness (greater than

500μm), vision image quality as well as the ophthalmic measurements can be influenced significantly by the tear film condition. The tear film quality is determined by its structure, composition, and thickness. The tear film possesses a free surface, which is secreted by the lacrimal gland, is lost via evaporation and drainage at the lacrimal ducts at the nasal side, and will eventually breakup in the absence of blinking.

The tear film breakup time (TBUT) is normally greater than 10 second for healthy tears. Pathologies of this film, or its production, are typically responsible for dry eye syndrome that possesses many features that are encompassed by the fluid mechanical and associated solute transport processes of the tear film. Studies in this are far from complete. Recently, the studies of tear film models. These studies show that the optical parameters of the tear film that can affect the accuracy and completeness of optical eye modeling include tear film thickness, post-blink tear undulation, tear breakup pattern, eyelid-produced bumps and ridges, bubbles, and rough pre-contact lens tear surfaces. These tear film characteristics in spatial and temporal domains can be included in the schematic eye models. The predictive modeling and simulation could yield insightful information regarding the dry eye vision and promote the diagnostics technology for the disease.

Important sign of dry eye is the reduction of fluorescein tear breakup time, indicating instability of the tear film [1]. Determination of tear breakup time requires prior instillation of fluorescein dye into the eye and is defined as the time taken for a dry spot to appear on the cornea after eye opening. It is possible for an astute technician to image the tear film breaking up, but the pattern observed will clearly depend on the exact time of image acquisition. For proper documentation of tear breakup, it is more appropriate to use videography instead of a single image. However, this may not be feasible as storage requirements of videos are extensive and may increase the cost of this measurement dramatically. One has to note that there are other variables in this test which may affect the tear breakup time, including the volume and concentration of the fluorescein dye instilled into the eye. As long as these parameters have not been universally agreed upon, videos of patients cannot be compared between different research centers. Even so, these modalities are useful for clinical monitoring of individual patients longitudinally and for comparison of patients imaged with the same methodology. In addition to tear breakup time, other phenomena can also be recorded by videography. For example, tear spreading pattern as well as the presence of moving debris on the tear layer can be documented.

Diagnostic Development

The development of more advanced diagnostic machines and wavefront technology have enabled an increased knowledge of optical aberrations [7]. This, in turn, has allowed for the customization of the laser refractive procedure with the end goal being minimized degradation of visual quality compared to

conventional laser corneal refractive surgery. In wavefront-guided refractive procedures, the excimer laser ablates a customized spatially variant pattern based on measurements taken with an aberrometer. Wavefront-guided LASIK and PRK have been performed clinically and have shown effectivity in treating myopia with and without astigmatism. There was significant improvement in UCVA (uncorrected near visual acuity) at 1 year, with good safety profiles—although faster recovery was noted with LASIK as opposed to PRK. Customized refractive procedures utilize information on the ocular aberrations and the topography of the patient as well as the refractive error in order to plan the ablation pattern to be executed. Clinical reports on outcomes with customized PRK and Femtosecond assisted LASIK have found that higher order and spherical aberrations increased with both procedures moreso with PRK than with LASIK, while total aberrations decreased. Sphere and cylinder were decreased from pre-operative values, and UDVA showed similar improvement for both procedures. As more information is being gathered on the impact of optical aberrations on vision and visual quality, more understanding will be gained on the utility and effectivity of these procedures for treating ammetropia. In the meantime, careful patient selection is advised with pre-operative counselling as to the details of both wavefront-guided and customized refractive procedures

Treatment

At present, dry eye has become a common ocular surface disease and its etiology is complex [9]. The central principle of dry eye treatment is to protect the patients' visual function, through supplementing or recovering the normal component of tears, to restore the normal anatomy of ocular surface, inhibit inflammation of the ocular surface, and eventually restore the normal anatomy and physiological function of the ocular surface and tear film. Currently, ten major drugs are clinically available for the treatment of dry eye, such as artificial tear substitute and lubricant, drugs to promote the secretion of tears, PAY receptor agonist, mucus-dissolving medicine, vitamin A agents, corticosteroids, nonsteroidal anti-inflammatory drugs, cyclosporine A, FK506, and autologous serum.

Artificial tear replacement therapy can relatively improve the lubrication degree of ocular surface and the humidity ocular surface, and even improve eyesight. The current artificial tear has several different dosage forms, including solution, gel, and ointment. The main difference is the viscosity, composition, and whether containing preservative or not. Artificial tear with low viscosity is a firstline drug for the treatment of mild dry eye, and artificial tear with high viscosity is the drug for treatment of moderate and severe dry eye. Ointment is used for night treatment. Polyethylene glycol eye drop is a high-molecular polymer with hydrophilic and film forming, and under the appropriate concentration will be attached to the ocular surface to protect ocular surface which is similar to tears. It is used to temporarily relieve symptoms caused by eye dryness, such as burning and tingling. The studies have found that after using polyethylene glycol eye drops, symptoms of dry eye patients have improved, and the majority

of patients were comfortable, with reading or watching computers for longer periods of time. It is a kind of artificial tear substitute with which the dry eye patients are more satisfied.

Conclusión

Dry eye syndrome occurs either due to insufficient tear secretion or due to disturbances in the quality of the tear film. Tears are necessary for lubrication, nutrition, health and optical functions of the anterior surface of the eye and clear vision. In addition, they reduce the possibility of infection, flush foreign bodies out of the eye and keep the surface of the eyes smooth and clean. With each blink of an eyelid, tears cover the front surface of the eye. Excess tears in the eye flow into the small drainage canals in the inner corner of the eye and further into the nasal cavity. Signs of dry eye syndrome are fibrous secretions and dry spots on the cornea in the area of the interpalpebral opening where the epithelium of the cornea and conjunctiva is exposed to evaporation, unlike the upper part of the cornea which is protected by the eyelid.

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