




Editorial

Exploring the Cutting Edge of Vision Science: New Developments in Diagnostics and Treatment of Ocular Surface in Dry Eye Disease

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The ocular surface refers to the outermost layer of the eye, which includes the cornea, conjunctiva and eyelids [1]. It is a complex and delicate system that is responsible for maintaining the health and function of the eye [2]. One common problem that can affect the ocular surface is dry eye syndrome, which is a multifactorial condition that occurs when the eye does not produce enough tears or the tears produced do not have the correct balance of water, mucus and oil, where inflammation, hyperosmolarity and neurosensorial abnormalities could coexist [3]. Dry eye syndrome can be caused by a variety of factors, including aging, certain medications and environmental conditions, such as prolonged use of the screen or living in a dry or dusty environment [3], or be related to autoimmune syndromes, where Sjögren syndrome stands out [4]. Symptoms and signs of dry eye syndrome include burning, itching or redness of the eye, as well as a sensation of dryness, grittiness or a foreign body sensation, among others. In severe cases, dry eye syndrome can cause vision problems, corneal damage and even blindness [5,6]. Effective treatment of dry eye syndrome requires an accurate diagnosis and a personalized treatment plan. Currently, the most common subjective method of diagnosing dry eye syndrome is through the use of questionnaires and subjective tests, such as the Ocular Surface Disease Index (OSDI) [7] or the Dry Eye Questionnaire (DEQ) [7]. Although these tests can be useful in identifying the presence of dry eye syndrome, they are based on self-reported symptoms and may not accurately reflect the true severity of the condition [7]. Moreover, traditional objective tests include the Oxford grading system with fluorescein stain or lissamine green stain, the tear break-up time test (TBUT) or the Schirmer test (I and II) [1–10]. Other adjuvant options are the measurement of the tear meniscus [11], the evaluation of the metalloproteinases [12] or the tear osmolarity [13].

A new measurement device, called the Ocular Surface Analyzer (OSA) [14], has recently been developed to help improve the diagnosis and management of dry eye syndrome. The OSA is a non-invasive, objective tool that uses interferometry to measure the thickness and surface profile of the tear film, similar to a Keratograph [15]. It can also measure blink rate and eyelid position, as well as TBUT. One of the key advantages of the OSA is its ability to provide detailed, quantitative data about the ocular surface [14]. This allows for a more accurate diagnosis of dry eye syndrome and allows for a more personalized treatment plan to be developed [16]. The OSA can also be used to monitor the effectiveness of treatment and track changes in the ocular surface over time [17]. There is growing evidence to suggest that OSA is a valuable tool in the diagnosis and management of dry eye syndrome [18]. A recent study found that OSA was able to accurately detect changes in the ocular surface in patients with dry eye syndrome and that it was able to distinguish between different



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severities of the condition [19]. Another study found that OSA was able to accurately predict the presence of dry eye syndrome in patients who had previously been diagnosed with the condition [20].

In general, OSA appears to be a promising new tool for the diagnosis and treatment of dry eye syndrome. Its non-invasive, objective measurements provide detailed, quantitative data about the ocular surface, which can help to improve the accuracy of diagnosis and the effectiveness of treatment. As research on OSA and its potential uses continues to be conducted, it is likely to become an increasingly valuable tool in the treatment of dry eye syndrome and other conditions that affect the ocular surface.

Second, dry eye disease is a common condition that occurs when the eye does not produce enough tears or the tears evaporate too quickly [21]. This can lead to a variety of symptoms, including dryness, irritation, redness and a feeling of discomfort or a foreign body sensation [7]. In severe cases, it can even cause vision problems [5]. The stability of the tear film is an important factor in the health and comfort of the eye [22–24]. The tear film is a thin layer of moisture that coats the surface of the eye and helps to keep it lubricated and protected [25]. It is made up of three layers: the outer layer, which is composed of oil produced by the meibomian glands [26,27]; the middle layer, which is made up of water produced by the lacrimal glands; and the inner layer, which is composed of mucus produced by the conjunctiva [10].

The tear film plays a critical role in maintaining the health of the eye by providing a protective barrier against dust, dirt and other irritants. It also helps keep the eye surface moist and comfortable, which is essential for good vision [6]. There are several factors that can affect tear film stability, including age, hormonal changes [16,28,29], medications [30,31] and certain medical conditions. Dry eye disease is one of the most common causes of tear film instability and is more common in women than in men, especially after menopause [16,28,29]. To treat dry eye disease, doctors may recommend the use of eye drops or ointments to supplement the natural tear film [6,9]. There are several types of eyedrops available, including artificial tears, which are designed to mimic the natural tear film; lubricating drops, which help to moisturize the eye; and anti-inflammatory drops, which reduce inflammation and redness [28–33].

In recent years, there has been a significant amount of research into the development of new eyedrop formulations that are more effective in treating dry eye disease. One promising area of research is the use of lipid-based eyedrops, which are designed to mimic the natural tear film more closely [33]. These drops are composed of a mixture of oils and water, and they are able to stay on the eye longer than traditional artificial tears. Another area of research is the use of nanotechnology to create eyedrops with smaller particle sizes that can be absorbed more easily by the eye [32]. These drops have the potential to provide more sustained relief from dry eye symptoms and may be more effective in improving tear film stability [22]. In general, dry eye disease is a common and often debilitating condition that can cause a variety of symptoms, including dryness, irritation and vision problems. Maintaining the stability of the tear film is an important factor in maintaining eye health and comfort, and new eyedrop formulations are being developed to improve the treatment of dry eye disease [34–40]. In more severe cases, other options, such as the use of corticosteroids, autologous or allogenic serum [41], immunomodulators or secretagogues and even surgical approaches [42], are necessary [6].

On the last point of discussion for this Editorial, the ocular surface microbiota, or the collection of microorganisms living on the surface of the eye, has long been recognized as an important factor in the health and function of the eye [43]. However, the specific role of the ocular surface microbiota in the development and management of eye diseases is still not fully understood [44]. Recently, a multicenter study proposed the concept of eye community state type (ECST) as a way to categorize and understand the different profiles of bacterial communities that can exist in the healthy eye [43]. The study found that nine different ECSTs could be identified within the healthy bacterial population. This is an exciting finding, as it suggests that there may be multiple “healthy” states of the

ocular surface microbiota and that different individuals may have different ECSTs. It also opens up the possibility of developing personalized approaches to eye care based on an individual's ECST.

However, more research is needed to fully understand the clinical implications of ECST and how it may be related to the development and management of eye diseases [45–48]. For example, it is not yet known whether certain ECSTs are more or less prone to developing eye infections or other problems. Overall, the concept of ECST is an interesting new avenue for research on the ocular surface microbiota and its role in eye health [49–51]. Further studies are needed to fully understand the clinical importance of ECST and how it can be used to improve the diagnosis and treatment of eye diseases. The field of vision science is constantly evolving, and there have been many exciting developments in the diagnosis and treatment of the ocular surface in dry eye disease. New technologies and approaches are being developed that have the potential to greatly improve the lives of those suffering from this common and often debilitating condition.

An important area of research is the development of new eyedrop formulations that are more effective at treating dry eye disease. Lipid-based eyedrops, which mimic the natural tear film, and nanotechnology-based drops with smaller particle sizes, which can be absorbed more easily by the eye, are both promising approaches that have the potential to provide more sustained relief from dry eye symptoms and improve tear film stability. In addition, advances in diagnostic techniques, such as the use of non-invasive imaging techniques, are helping to improve the accuracy and reliability of dry eye diagnoses. This is important because it allows physicians to more effectively tailor treatment plans to the specific needs of each patient.

In general, the cutting edge of vision science provides new and innovative ways to diagnose and treat ocular surface conditions, including dry eye disease. These developments have the potential to greatly improve the lives of those affected by this condition and to help them maintain the health and comfort of their eyes.

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