Contact Lens Update
CLINICAL INSIGHTS BASED IN CURRENT RESEARCH

# The Relationship between Dry Eye Disease and Digital Screen Use

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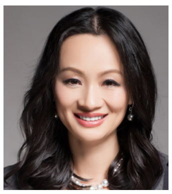

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***Zaina Al-Mohtaseb, Scott Schachter, Bridgitte Shen Lee, Jaclyn Garlich, William Trattler. The Relationship Between Dry Eye Disease and Digital Screen Use. Clinical Ophthalmology. 2021, September 10;15:3811-3820.***

As primary eye care providers, we frequently see how eye health is impacted by digital lifestyles, with one of the common symptoms reported by patients being reports of 'dry eyes'.[1] Reports of ocular dryness have increased during the COVID-19 pandemic, linked to increased use of digital devices for home working, online education, and increased use for social activities.[2]

A recent review was undertaken to examine any potential relationship between dry eye disease (DED) and digital screen use (DSU).[3] A thorough search was conducted to review the literature on the topic of DED as it relates to DSU. Key search terms included "dry eye," "visual display," "blink," "digital screen," and "screen use" in various combinations. Articles were selected for a narrative review if the information was pertinent to discussing the associations between digital screen use and dry eye, ocular surface measures, and blinking dynamics including blink rate and blink completeness. Articles on the impact of dry eye on quality of life and preventive strategies for digital screen users were also reviewed.

**Relationship between digital screen use and dry eye disease**

Several large cross-sectional studies have demonstrated a direct relationship between digital screen use and dry eye. The Uchino study (N=3549),[4] Inomata study (N=4454)[5] and OSAKA study (N=561)[6] each demonstrated that longer duration of screen use of >4 hours and >8 hours resulted in more frequently reported dryness symptoms. The large JPHC-NEXT study (N=102,585)[7] found that greater digital screen use was associated with a higher risk of clinically diagnosed DED (Odds Ratio (OR)=1.18 for each 1 hour/day increment) and severe symptoms of dry eye (OR=1.11 for men and 1.12 for women for each 1 hour/day increment). The Wolffsohn study (N=1125)[8] demonstrated that higher digital screen time per day was a risk factor for both DED (OR=1.09) and specifically for evaporative DED (OR=1.08).

Typically, eye care practitioners may only look for signs and symptoms of DED in adults. However, similar impacts of DSU are found in school age children, as demonstrated in two studies by Moon and co-workers (2014, age 10-12 with N=288; 2016, age 7-12 with N=916).[9, 10] In the 2016 study,10 the prevalence of smartphone use was higher in the DED group than the non-DED group (96.7% vs 55.4%) and the daily duration of smartphone and computer use was higher in the DED group (3.18 hours and 1.10 hours) than in the non-DED group (0.62 hours and 0.76 hours respectively). When children with DED stopped smartphone use for four weeks, all showed an improvement in both signs and symptoms, as determined by superficial punctate epithelial erosions (SPK), tear breakup time (TBUT), and OSDI score, which suggests lifestyle modifications can help to improve DED in some young digital screen users.

**Relationship between digital screen use and ocular surface measures**

Several studies assessed the relationship between DSU and a variety of ocular surface metrics, including tear breakup time (TBUT), tear volume (eg, tear meniscus height [TMH] and Schirmer score), and tear film lipid layer status.

Several studies demonstrated TBUT decreased in gamers and frequent users of digital devices, suggesting that DSU is associated with an acute deterioration of tear film quality.[11-13] A Japanese study involving 1025 office workers demonstrated that >8 hours of daily digital screen use was associated with a reduced Schirmer I score (≤5mm) compared with <2 hours of daily digital screen use (OR=4.27).[14] Furthermore, working on digital screens for 8–12 years (OR=2.49) or >12 years (OR=3.61) was associated with a reduced Schirmer I score (≤5 mm) compared to <4 years, suggesting that DED worsens with cumulative years of digital device use.

Studies have investigated whether DSU impacts the individual layers of the tear film, with one showing a reduction in the aqueous component of the tear film (as determined by assessment of the TMH)[15] and another demonstrating that tear film mucin concentration may be lower in those with high daily digital device use, with MUC 5AC concentration being lower in those using digital screens >7 hours per day compared to <5 hours per day.[16] Long-time screen workers were also found to have higher lid margin abnormality scores, greater meibomian gland loss, and worse expression of meibum than those using screens for a shorter period of time (≤ 4 hours per day).[17]

**Effect of digital screen use on blinking dynamics**

The most prevalent hypothesis on the link between digital screen use and dry eye is that DSU influences blinking dynamics by reducing both blink rate and blink completeness, leading to increased ocular surface dryness. Aqueous tears evaporate from the tear film during the interval between each blink, and full blinking is required to replenish the tear film by distributing tears (from lacrimal glands) and lipids (from meibomian glands) over the ocular surface.  Thus, reduced and incomplete blinking results in ocular surface dryness by allowing greater evaporative loss, which could, over time, potentially initiate the DED cycle.

Several studies support the hypothesis that digital screen use leads to dry eye by affecting blinking dynamics.[11, 18-21] Blink rate is lower with more active digital device use, such as computer games or more active computer tasks than when reading or in a resting state.  As with blink rate, the percentage of incomplete blinks increases with active DSU tasks, and Cardona et al found the percentage of incomplete blinks increased compared to baseline during video-game playing.[11] Prabhasawat et al found that the percentage of incomplete blinks and burning symptoms was significantly higher following e-book reading than when reading from a printed book[22] and Chu and colleagues found the percentage of incomplete blinks was 7.02% when reading from a computer compared to 4.33% when reading a hard-copy.[23] These results emphasize that reading on a digital screen may promote adverse effects by reducing both blink rate and blink completeness.

**Management of digital screen–induced dry eye**

A combination of ocular therapies, discussions around healthy digital device ‘habits” and lifestyle modifications may prove beneficial to reduce dry eye symptoms from digital device use.

Use of an ocular lubricant, blinking exercises, frequent breaks from viewing the device, optimal computer station ergonomics, and generally reduced digital device use are some helpful measures.  In addition, strategies that may help in management of digital eye strain (computer vision syndrome) – a broader category of eye and vision problems related to digital screen use – such as enlarging font size, reducing glare, improving contrast, and using a downward gaze may also be beneficial for those with symptoms of dry eye. As eye strain from digital screens may make overall symptoms worse, management of refractive error and/or binocular dysfunction may also help.

It is important for eye care professionals to raise patients' awareness of the link between DED and digital screen use, and to discuss prevention strategies. Early diagnosis and management of dry eye is important for preventing and reducing the possible negative impact of DED on quality of life and work productivity.

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