LEARNING DOMAINS

CLINICAL PRACTICE

SPECIALTY: CONTACT LENS OPTICIANS

COMMUNICATION

PROFESSIONAL GROUPS

Dispensing opticians — CPD PROVIDER — General Optical Council

Optometrists — CPD PROVIDER — General Optical Council

Contact lens opticians — CPD PROVIDER — General Optical Council

CPD CODE: C-109123

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This CPD session is open to all FBDO members and associate member optometrists. Successful completion of this CPD session will provide you with a certificate of completion of one non-interactive CPD point. The multiple-choice questions (MCQs) are available online from Sunday 1 September 2024. Visit **abdo.org.uk**. After member login, scroll down and you will find CPD Online within your personalised dashboard. Six questions will be presented in a random order. Please ensure that your email address and GOC number are up-to-date. The pass mark is 60 per cent.

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Digital eye strain

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Digital eye strain (DES) is a condition encompassing visual and ocular symptoms that may arise due to the prolonged use of digital devices. The 2023 Tear Film Ocular Surface Lifestyle[1] report defined DES as: "The development or exacerbation of recurrent ocular symptoms and/or signs related specifically to digital device screen viewing". Studies vary as to the prevalence of DES – with some reporting values as low as 10 per cent and some reporting values over 90 per cent.

In the first of its kind, a study by this author found the prevalence of DES in Ireland and the UK to be 62.6 per cent[2,3]. A survey of UK and Irish optometrists in 2021[4] found that 88.9 per cent of respondents agreed that DES was an important concern for them – and more than 90 per cent agreed that it may cause frequent and persistent symptoms for sufferers. Additionally, more than 90 per cent agreed that they felt confident in discussing the condition and advising their patients on its management (**Table 1**).

The use of various digital devices has become ubiquitous amongst all age groups – with the typical digital consumer owning around four devices[5]. The average American adult now has access to at least 10 digital devices[1]. The majority of adults and children spend significant amounts of time using digital devices – for social activities, work and increasingly education[6-9].

In recent years, the use of hand-held electronic devices, such as smartphones, tablets and e-readers, has increased substantially[10,11]; these devices present different visual challenges compared to desktop or laptop computers. Unlike traditional desktop computers, tablet computers and other hand-held devices can be used at different viewing

	PERCENTAGE OF OPTOMETRISTS		
	Agree	Disagree	Neither agree nor disagree
DES is an important concern for optometrists	**88.9%**	**6.2%**	**4.9%**
DES may cause frequent and persistent symptoms for sufferers	**91.9%**	**3.0%**	**5.2%**
I feel confident discussing ocular symptoms associated with computer usage and advising on management options	**91.4%**	**3.2%**	**5.4%**

TABLE 1: Attitude of optometrists towards DES as found by Moore *et al*[4]

distances and angles – and often require smaller font sizes because of the reduced screen size, which imposes significant demands on the visual system[12]. Furthermore, hand-held electronic displays, such as e-readers, may be associated with greater risk of discomfort from improper lighting[10].

Since the onset of the COVID-19 pandemic in early 2020, the prevalence of DES is likely to have increased because of the extensive use of digital devices for home working (where workstations designed for comfortable computer use may not be available), entertainment activities and tasks such as home shopping[9,13-16]. In addition, the pandemic resulted in large numbers of educational programmes at all levels shifting from face-to-face to online, further increasing the use of digital devices and the risk of DES.

It is estimated that the prevalence of DES in children rose from about 18 per cent before the pandemic[17] to 50 to 60 per cent during the pandemic[18-20]. Furthermore, in their 2021 study McCrann *et al*[21] demonstrated an association between myopia and smartphone use in primary, secondary and tertiary level students.

SYMPTOMS OF DES

Symptoms of DES typically include eye strain, eye fatigue, burning and irritation of the eyes, headache, tired eyes, dry eyes, ache in and around the eyes, blurred vision at near, blurred vision when looking from near to distance, neck ache and shoulder pain[12,22-26]. **Table 2** shows a classification devised by Blehm *et al*[27] along with possible causes.

In most cases, symptoms of DES are mild and transient but, in some cases, they can be more persistent and frequent[22,26]. It has been reported that the extent to which a user may experience symptoms is dependent on their visual acuity in relation to the visual demands of the task being performed, with symptoms being more pronounced in those with reduced visual acuity[28]. Moreover, duration of device use[29], form of visual correction, i.e. spectacles, contact lenses or specific computer spectacles[30,31], sex[32,33] and ocular surface status[12,34] have been shown to be related to the presence and severity of symptoms.

SYMPTOM CATEGORY	SYMPTOMS	POSSIBLE CAUSES
Asthenopic	• Eye strain • Tired eyes, sore eyes	• Binocular vision or accommodation dysfunction
Ocular surface related	• Dry eyes • Watery eyes • Irritated eyes • Contact lens problems	
Visual	• Blurred vision • Slowness of focus change • Double vision • Presbyopia	• Refractive error • Accommodation or binocular vision dysfunction
Extraocular	• Neck pain • Back pain • Shoulder pain	• Computer/digital device screen location

TABLE 2: Main categories of symptoms in DES as categorised by Blehm *et al*[27]

Given the high prevalence of the syndrome, dispensing opticians (DOs), contact lens opticians (CLOs) and optometrists in general practice are likely to be consulted by patients suffering from DES. The eyecare practitioner should be able to give relevant clinical and practical advice to patients who present with such symptoms[4].

DETECTION OF DES

In practice, the detection or diagnosis of DES can be achieved in a number of ways. During their consultation, the patient will often report symptoms of DES to their optometrist or CLO. The practitioner should then further investigate the symptoms with the patient to determine if they are likely to be due to their digital device use or other factors. If the practitioner does conclude that the patient is suffering from DES then they should advise the patient of ways to reduce their symptoms (*discussed further later*).

Dry eyes is a common symptom of DES; this may be attributed to a reduced blink rate and/or incomplete blinking, which has been shown to occur during screen use and can lead to poor tear film quality[35,36]. Decreased and incomplete blinking and tear evaporation while using digital devices causes ocular surface changes and can result in sore and tired eyes[11,37].

Using a topical lubricant has been shown to be effective in countering the symptoms of dry eyes[29,36,38]. Contact lens wearers have been found to be significantly more likely than non-wearers to suffer from dry eye symptoms when using digital devices[30,39-41]. González-Méijome *et al*[39] reported that 83 per cent of male and 87 per cent of female contact lens wearers had at least one dry eye symptom compared to 68 per cent of male and 73 per cent of female non wearers. Symptoms were more prominent in the contact lens wearers who used computers for between three and six hours than those who used one for fewer hours.

A number of questionnaires have been developed to aid in the diagnosis of DES. Perhaps the most well known of these is the Computer Vision Syndrome Questionnaire (CVS-Q) developed in 2015 by del Mar Segui and colleagues[42]. It assesses the frequency and intensity of 16 symptoms using a single rating scale of symptom severity, and is shown in **Figure 1**. The questionnaire has been validated and can be done by the patient in a few minutes, with the results calculated by the practitioner very quickly thereafter.

COMPUTER VISION SYNDROME QUESTIONNAIRE (CVS-Q)

To be completed by worker

Indicate whether you experience any of the following symptoms during the time you use the computer at work. For each symptom, mark with an **X:**

a. First, the **frequency**, that is, how often the symptom occurs, considering that:
NEVER = the symptom does not occur at all
OCCASIONALLY = sporadic episodes or once a week
OFTEN OR ALWAYS = 2 or 3 times a week or almost every day

b. Second, the **intensity** of the symptom.
Remember: if you indicated NEVER for frequency, you should not mark anything for intensity.

	a. Frequency			b. Intensity	
	NEVER	OCCASIONALLY	OFTEN OR ALWAYS	MODERATE	INTENSE
1. Burning					
2. Itching					
3. Feeling of a foreign body					
4. Tearing					
5. Excessive blinking					
6. Eye redness					
7. Eye pain					
8. Heavy eyelids					
9. Dryness					
10. Blurred vision					
11. Double vision					
12. Difficulty focusing for near vision					
13. Increased sensitivity to light					
14. Coloured halos around objects					
15. Feeling that sight is worsening					
16. Headache					

To be completed by investigator

Calculation of **TOTAL SCORE.** Apply the following expression:

$$\text{Score} = \sum_{i=1}^{16} (\text{frequency of symptom occurrence})_i \times (\text{intensity of symptom})_i$$

Considering that: **Frequency:** Never = 0; Occasionally = 1; Often or always = 2 **Intensity:** Moderate = 1; Intense = 2

If the total score is ≥6 points, the worker is considered to suffer Computer Vision Syndrome (CVS)

FIGURE 1: Computer Vision Syndrome Questionnaire as developed by del Mar Segui *et al*[42]

The CVS-Q is a useful tool to have in practice – especially if a practitioner sees a lot of patients with DES, or suspected DES. It can even be used as a means of monitoring the condition in the patient after advising them on a course of action to reduce their symptoms.

MANAGEMENT OF DES

Several factors will cause, or contribute to the occurrence of, DES in a typical digital device user – and it is likely that a combination of these factors will lead to a greater level of symptoms in the user[27].

THE OCULAR SURFACE

The Tear Film and Ocular Surface Society (TFOS) DEWS II epidemiology report listed digital device use as consistent risk factor for dry eye disease[43]. Given this, it is believed that individuals with pre-existing dry eye conditions are at an increased risk of suffering from digital device induced dryness – and it is commonly found in device users who have otherwise healthy eyes[34,44,45].

Digital device use can disrupt blink patterns, ocular surface homeostasis and tear film function in both children and adults[11,46-49]. Generally, a higher level of dry eye symptoms is found in females than in males[43,50]. Alterations in humidity (both high and low) or direct airflow exposure have been associated with dry eye symptoms, especially in indoor settings[8,51-54]. The regular use of lubricating eye drops has been shown to reduce, but not eliminate, dry eye symptoms as well as some symptoms of tiredness and focusing difficulties[1,27].

The effects of decreased or incomplete blinking on dry eye must also be considered. It may be useful to introduce blink training to computer users, where the user is prompted by their device to blink regularly using a message on screen or by an audible cue[37]. Lubricating drops are especially important in older adults because of the link between dry eye and age as outlined in the TFOS DEWS II report[55] with each decade of life being associated with a 24 per cent increase in the odds of developing dry eye disease[56].

Blinking exercises have been shown to modify impaired blinking patterns and relieve the symptoms of dry eye[35]. Practitioners could advise their patients who experience dry eye while using digital devices to perform these exercises to help to reduce the severity of their symptoms.

An example of such an exercise developed by Murakami *et al*[57] is as follows:

- Gently close the eyes for two seconds
- Open the eyes
- Gently close the eyes again for two seconds
- While keeping the eyes closed, squeeze the eyes for two seconds
- Open the eyes
- Repeat this cycle every 20 minutes during waking hours

Although this exercise was originally developed for the relief of evaporative dry eye disease, it could be useful for those suffering from dry eye while using a digital device.

SCREEN POSITIONING

The positioning of the display screen or digital device is an important factor when dealing with DES (**Figure 2**). Device users often adopt an unusual posture to allow them to see the screen or device clearly. As a result, the user will often experience pain or discomfort in their back, shoulders, neck or wrists when using the device[8]. Therefore, the position of the device must be considered carefully when setting up a work station because improvements to it have been shown to reduce symptoms and improve performance[58].

A viewing distance of approximately 50-65cm is usually recommended[59,60]. Screen height is also important. The screen should be placed 10-20˚ below eye level[61]. If the screen is higher than this, the user will often tilt their neck upwards resulting in muscle strain and discomfort[24,61]. Lowering the screen downwards allows the device user to look downwards thereby narrowing the palpebral aperture and reducing the area of the ocular surface exposed, which will help reduce tear film evaporation[62].

Additionally, any other documents, paperwork etc, should be positioned in the same plane as the screen so as to have a similar viewing distance and therefore reduce accommodative stress on the user[63].

REFRACTIVE ERROR

Correction of refractive error, especially astigmatism and presbyopia, is accepted as an important way to help with symptoms of DES[64-66]. Uncorrected astigmatism may be a concern for presbyopic patients who choose to use ready-made reading glasses because these optical devices do not contain a correction for astigmatism[67]. Contact lens wearers with small, uncorrected astigmatism can also suffer because of a similar problem[65].

FIGURE 2: Screen or digital device positioning is an important factor in DES

The variety of working distances that occur when using different digital devices can also cause problems for presbyopic individuals. Smartphones use small fonts because of their small screen size and are typically viewed at around 32cm[10,62], a minimum viewing distance of between 55-63.5cm is recommended for a desktop computer[59] and 50cm for e-readers[68]. Therefore, a single near addition may not be sufficient for the range of viewing distances involved. Presbyopes will often require multiple prescriptions/spectacles or a specialist occupational type lens that combines the intermediate prescription and near prescription. Such occupational lenses have been shown to reduce symptoms in presbyopic device users to a greater extent than workstation changes: an 80.7 per cent reduction due to the occupational spectacles compared with 19.3 per cent with the work station set-up[69]. Horgen *et al*[31] showed that some designs of specialist occupational lenses gave greater overall satisfaction than that achieved using single vision lenses.

TAKING BREAKS

Taking adequate breaks from digital devices is believed to have a dramatic effect in controlling the symptoms of DES as well as improving work efficiency[70,71]. However, Reddy *et al*[72] reported that taking breaks by itself was not associated with reduced symptoms – whereas looking at far objects during a break was.

The 20/20/20 strategy, where after 20 minutes of screen use the user looks at objects 20 feet away for 20 seconds, is a popular recommendation and is frequently recommended in practice[72-74] and by organisations such as the American Optometric Association[75] and the American Academy of Ophthalmology[76]. Indeed, Talens-Estarelles *et al*[77] found the 20/20/20 rule is an effective strategy for reducing DES and dry eye symptoms in device users.

Despite these reported benefits of the 20/20/20 strategy, many patients will not do it correctly or will simply stop doing it after a short period of time and, as such, its benefits may not be long-term[78].

BLUE LIGHT

Modern digital devices, including computers, tablets, smartphones and e-readers emit 'blue light' – also referred to as 'high energy visible light'. Blue light is typically defined as visible wavelengths between 400-500nm[79-81]. The impact of blue light on the eye has gained increased interest in the last several years given the increasing use of digital devices. However, even with long hours of use, the level of blue light exposure from digital devices is significantly less than the levels of blue light exposure from normal daylight – and well below international safety limits[82].

Despite this, excessive exposure to blue light has been suggested to cause DES and sleep disruption following night-time blue light exposure[83,84]. However more recent studies have found no benefit to post-cataract patients receiving blue-light blocking intraocular lenses (IOL) in terms of sleep quality as compared to those receiving ultraviolet-light blocking IOLs[85]. Furthermore a 10-year study in Taiwan found no difference in the occurrence of age-related macular degeneration (AMD) in patients receiving a blue-light blocking IOL to those patients receiving a non-blue-light blocking IOL[86].

Several optical manufacturers are now marketing spectacle lenses that include 'blue-blocking' or 'blue-reducing' filters that reduce the transmission of UV light (200-400nm), short wavelength light (380-440nm) and blue light (440-500nm)[87,88]. Claims have been made that these lenses potentially reduce eye strain[89], improve quality of sleep[83] and protect against retinal cell damage[90]. However, there is limited evidence to suggest that DES results from exposure to blue light from digital devices[91,92].

In 2019, Palavets and Rosenfield[88] examined the effect of a blue-blocking filter on symptoms of DES during a sustained near task. The filter used blocked 99 per cent of wavelengths between 400-500nm, while the control group used a neutral density filter. The results showed that the blue-blocking filter was no better in reducing symptoms of DES than the neutral density filter. This finding was replicated in a 2022 study by Adams *et al*[85].

The College of Optometrists (UK) has issued guidance regarding blue light lenses and has stated that: *"The best scientific evidence currently available does not support the use of blue-blocking lenses in the general population to improve visual performance, alleviate the symptoms of eye fatigue or visual discomfort, improve sleep quality or conserve macular health"*[93].

The College's position paper further states that if a practitioner is dispensing blue-blocking lenses then they should inform their patients that there is "no strong evidence" that that these lenses alleviate the symptoms of DES and that it is also *"unclear if the filtering of blue-light preserves macular health or alters the risks associated with the development or progression of AMD"*.

CONCLUSION

The extensive use of digital devices for work, socialising and entertainment is now customary amongst people of all ages. Given the ocular nature of many of the symptoms of DES, many sufferers will likely attend their eyecare practitioner for advice (even if this is not their primary reason for the visit) and, as such, it is important that the profession is well informed of the evidence regarding the condition.

Prevention of DES and modification of the way devices are used is the main strategy for the management of DES[94]. Those suffering from DES should have a full refractive correction for the appropriate working distances. The device user needs an ergonomically designed workplace environment to limit symptoms. The use of hand-held digital devices is likely to increase and these devices will require specific guidance because of the difference in the modality of their use compared to 'traditional' desktop or laptop computers[62].

Guidance on maintaining normal blinking patterns, taking regular breaks and the use of ocular lubricants also needs to be provided. The topic of blue light will undoubtably continue to make headlines, and practitioners should give patients the best evidence-based advice currently available when deciding to recommend these lenses in their practice.

REFERENCES

References can be found when completing this CPD module. For a PDF of this article with references email, abdocpd@abdo.org.uk

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LEARNING OUTCOMES FOR THIS CPD ARTICLE

DOMAIN: Communication

1.8: *Support patients in caring for themselves, including giving advice on the effects of their lifestyle and environment that may impact digital eye strain, and support them in making changes where appropriate.*

DOMAIN: Clinical Practice

5.3: *Be aware of the latest research in the area of digital eyestrain and apply this to the care you provide relevant to your professional role and scope of practice.*

7.1: *Considering your professional role, conduct an adequate assessment for the purposes of the optical consultation, including where necessary obtaining relevant information on their environment and lifestyle.*

7.5: *Provide effective patient care and treatments based on current good practice.*

DOMAIN: CL speciality

Considering your professional role conduct an adequate consultation to uncover signs and symptoms of digital eye strain where present and provide appropriate advice and management.

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