

Eye strain

Focus on causes and treatment

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Eye strain is relatively common and can have a major impact on work or study. GPs are ideally placed to assess contributing factors, exclude potentially serious conditions that have similar symptoms and facilitate specialist referral.

Eye strain (asthenopia) refers to a collection of nonspecific ocular symptoms, including ocular fatigue, discomfort, tearing, blurred vision, diplopia and headaches. GPs are often the initial choice for patients seeking investigation of eye symptoms. As a wide range of conditions may present with symptoms similar to eye strain, it is important not to miss a potentially serious condition that requires immediate referral and treatment (Box 1).

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KEY POINTS

- Eye strain (asthenopia) is relatively common across all age groups and can lead to a range of nonspecific symptoms, including ocular fatigue, discomfort, tearing, blurred vision, diplopia and headaches.
- Patients with eye strain often present to a GP as the initial point of care.
- It is important for GPs to exclude potentially serious conditions that present with similar symptoms and require immediate referral and treatment.
- After eye strain is diagnosed, contributing causes may not be readily apparent and investigation of both ocular and general health may be required.
- GPs are well placed to guide the general care and referral pathway for patients with eye strain.
- A combined approach involving the GP, ophthalmologist and other specialists may be required.

The impact of eye strain varies considerably, from mild discomfort to significant disruption that may reduce efficiency or require time off study or work. Identifying the primary cause can be difficult, and a multidisciplinary approach involving the GP and eye care professionals is often required.

In this article, we outline the causes, presentation and diagnosis of eye strain. We also discuss how GPs can identify factors contributing to eye strain and formulate the most appropriate referral pathway.

1. CONDITIONS THAT CAN CAUSE SYMPTOMS SIMILAR TO EYE STRAIN

Ocular causes

- Ocular inflammation (e.g. uveitis, iritis)
- Third, fourth or sixth cranial nerve palsy
- Glaucoma
- Ocular emergency (e.g. papilloedema)*

Nonocular causes

- Migraine
- Uncontrolled systemic disease (e.g. diabetes, hypertension, autoimmune disease)
- Change or increase in medication (e.g. antianxiety or antidepressant medication, which can cause blurred vision)
- Bacterial or viral illness
- Intracranial bleed
- Tumour

* Although ocular emergencies may lead to vision disturbance and ocular pain or discomfort, symptoms are likely to be significantly greater than in patients with eye strain.

Epidemiology of eye strain

Eye strain can affect all levels of the population but appears to be most frequent in the second and third decades of life, with a general decline in incidence from the fourth decade.¹ Unsurprisingly, the peak incidence corresponds to a time of increased visual stress for many people, during secondary and tertiary education and initial career opportunities. In a large series of university students, over half (57%) complained of eye strain at some stage.² Symptoms were significantly associated with computer use and influenced by psychosocial state, dietary habits and environmental conditions, suggesting that a broad approach to diagnosis and treatment is essential.

The incidence of eye strain symptoms in schoolchildren is lower but also considerable. Symptoms were reported by 20% of a sample of schoolchildren in Korea and 23% of a young Swedish population aged 6 to 16 years.^{3,4} Of note in the Swedish group, all but two of the children with

symptoms had abnormal results on eye examination, confirming the importance of ophthalmic investigation in young people with eye strain.

Career and work environment are important considerations. A study found that eye strain is more prevalent in professional computer users who undertake long hours of continuous computer work.⁵ There was an additional association with female sex, which has been found elsewhere, albeit in small cohorts.⁶

Pre-existing eye conditions affect the incidence of eye strain.^{4,5} Uncorrected refractive error or extraocular muscle imbalance can increase symptoms of eye strain. Visual stress has also been reported in other conditions. For example, up to 20% of patients with dyslexia reported visual fatigue, visual perceptual distortions and headaches after episodes of repetitive near work.⁷

Symptoms of eye strain

Symptoms of eye strain vary considerably between patients and may include headaches, general eye discomfort or fatigue and visual distortions. Ocular symptoms particular to eye strain may include distance blur (when looking from near to far), difficulty refocusing, diplopia, increased light sensitivity, dry eye and a burning sensation.⁶ A strong indicator of visual stress is the perception of words 'moving' when reading, or tired uncomfortable eyes after prolonged near work.⁸

Causes of eye strain

A combination of ocular, general health and environmental factors can contribute to eye strain (Box 2).

Ocular causes

Specific ocular symptoms may suggest the possible cause. A study found that people with uncorrected refractive error were more likely to report eye strain and headaches.⁹ Poor or reduced corrected acuity (with glasses or contact lenses) increases the difficulty of visual tasks and can exacerbate eye strain.

2. FACTORS THAT CAN CONTRIBUTE TO EYE STRAIN

Ocular factors

- Uncorrected refractive error
- Presbyopia
- Reduced convergence
- Reduced accommodation (relative to age)
- Decompensating heterophoria (intermittent loss of binocular vision)
- Dry eye (may be exacerbated by contact lens use)
- Poorly fitting or misaligned glasses (including reading glasses)
- Reduced corrected visual acuity

Nonocular factors

- Anxiety or stress
- Fatigue
- Sleep apnoea
- Cerebral hyperexcitability (e.g. after stroke)
- Traumatic brain injury
- Drugs (e.g. anti-anxiety and antidepressant medications)
- Inflammation

Environmental factors

- Computer use
- Smartphone and tablet use
- Poor work-station ergonomics

Reduced convergence (ability to maintain a single image of an object at close range) may lead to migraine, eye pain and diplopia, particularly after extended near work (Figures 1a to c).¹⁰ Poor accommodation (ability to focus at near distance) may lead to difficulty in focusing from near to far (distance blur) or general blur during reading, which patients may describe as 'floating' or 'moving' print (Figure 2).¹¹ Accommodation is age-dependent and may also be influenced by refractive error or general health. Decompensated ocular motor function leading to intermittent or constant strabismus (turned eye) can cause diplopia, particularly in adults.

Optical devices can contribute to ocular symptoms. Extended contact lens use and



Figures 1a to c. Convergence testing. a (left). The patient is asked to focus on a target and to maintain a single image. b (centre). The target is then slowly moved towards the patient. c (right). The patient has lost convergence. Note the right eye has diverged from the target.

poor blinking function can lead to intermittent blur and dry eye. Poorly fitting or misaligned glasses, as may occur with over-the-counter reading glasses, can increase ocular strain leading to blur or diplopia.¹² Foreign body sensation, light sensitivity and fluctuations in vision, which are common in patients with clinical dry eye, can exacerbate general ocular discomfort and strain.

General health contributing factors

Nonocular causes of eye strain are relatively common. Fatigue and anxiety can exacerbate general ocular symptoms. Significant ocular fatigue and restriction of the effective field of vision have been identified in drivers with sleep apnoea compared with normal subjects, highlighting definitive practical concerns.¹³

Visual stress resulting from cerebral hyperexcitability occurs in a range of neurological conditions, including stroke.¹⁴ Symptoms may include headaches, glare complaints and eye strain with minimal provocation.

Traumatic brain injury can have a significant impact on the visual system leading to eye strain, reading problems, blurred vision, diplopia and vertigo.¹⁵ Early review of visual capabilities after the trauma may be key to minimising general functional problems and facilitating recovery. Postinjury medications, including anti-anxiety medications, anticonvulsants and antidepressants, have been

implicated in blurred vision and eye strain, but the effects may be indistinguishable from those of the injury itself.¹⁶

Anxiety can manifest with general symptoms. For example, it was recently suggested that anxiety about job security may lead to increasing headaches, eye strain and general concerns such as skin problems, albeit in a small subgroup of patients who are more responsive to stress conditions.¹⁷

In rare cases, eye strain has been the presenting symptom of inflammation. For example, in a retrospective review of 100 consecutive cases of allergic fungal sinusitis, 34% of patients reported ocular symptoms, including visual disturbance, epiphoria and double vision.¹⁸ In a separate case report of a patient with allergic fungal sinusitis, inflammation led to displacement of the medial rectus muscles, which induced symptoms of eye strain. These symptoms improved after surgical treatment.¹⁹ This highlights the variety of potential contributing factors to eye strain.

Environmental causes

The increasing use of near vision in both work and leisure activities may contribute to visual discomfort, although the effect varies between individuals. Computer use for longer than six hours per day was found to lead to visual symptoms in 72% of users, with a quarter describing moderate to severe complaints. Patients in the pre-presbyopia stage (about age 40 to

45 years) were likely to be more affected, because of declining accommodation ranges.⁶ Decreased blink rate, common among computer users, can increase dry eye symptoms leading to ocular discomfort, which may be exacerbated by airconditioning.



Figure 2. Accommodation testing. The patient is asked to maintain a clear image as a print target is moved towards the nose. The near point of accommodation is the point where the print is no longer clear. The RAF (Royal Air Force) rule was developed for this test and provides age-related normative values. A print target can be used as an alternative, albeit without normative values.



Figures 3a and b. Ideal distance from the computer monitor. a (left). The worker is sitting too high and too close to the screen. Note her hunched posture. b (right). The worker is sitting at a more appropriate height and distance from the screen, with a more relaxed posture. The ideal distance from the screen varies between individuals but is generally about 75 cm.

The type of computer monitor used may also influence discomfort. A study found that the incidence of eye pain in volunteers was greater after use of flat-screen monitors than curved-screen monitors.¹¹ The authors proposed that the monitor type influenced the near point of accommodation. Three-dimensional (3D) and virtual reality units are increasingly used for entertainment. Although results of studies on their impact vary, the literature supports a possible role of 3D animation and movies in increased visual fatigue.²⁰ The term 'computer vision syndrome' has been suggested to describe the

collection of symptoms related to close work but would be synonymous with eye strain.²¹

Poor ergonomics of the work station, including inappropriate intensity and direction of lighting, glare and poor positioning of monitors can manifest as both visual and musculoskeletal problems (Figures 3a and b). Ergonomics should be considered if no contributing ocular or general health conditions are identified and eye strain symptoms do not resolve with basic treatment.²²

Research also highlights how the use of devices such as smartphones and

tablets can contribute to visual stress. Smartphone users were found to move the viewing distance of their phones closer with prolonged use (60 minutes or more), increasing eye strain symptoms in some users.⁸ Furthermore, users tended to hold their devices closer when they were lying down than when sitting.⁸

Diagnosis

Ocular symptoms such as sore, gritty and watery eyes, ocular fatigue or discomfort, intermittent blurred vision, headaches or double vision can be caused by eye strain or a wide range of other conditions. In patients with these symptoms, it is important for GPs to identify any potentially serious conditions that require immediate referral and treatment (Box 1).

Detailed history-taking, examination and investigation are imperative. Questions for the GP to consider include:

- Does the patient also have sinus problems?
- If they have a headache, what is the cause?
- Could it be something more sinister (e.g. a brain tumour or cerebral bleed)?
- Is it uveitis, glaucoma or an ocular emergency?
- Does the patient have a systemic health problem (e.g. diabetes, an autoimmune process or uncontrolled hypertension, which can all have eye-related signs and symptoms)?

Points to cover in history-taking in a patient with eye strain symptoms are summarised in Box 3. Low- and high-risk features of the history and of both ocular and physical examination are shown in the Table.

Presentation with headache

In patients who present with headache, it is important to ask about vision and visual tasks as well as assessing for more sinister problems, as many patients do not associate headache with eye problems. It is also important to explore the history of the headaches, their duration, severity,

3. FEATURES TO COVER IN HISTORY-TAKING FROM PATIENTS WITH EYE STRAIN SYMPTOMS

- Duration and severity of symptoms (to determine likelihood of an ocular or systemic condition)
- Precipitating factors (to determine potential for ocular or systemic origin)
- General health and lifestyle concerns (to assess possible contribution of general or systemic risk factors, stress or anxiety)
- Current use or change of medication
- Do symptoms resolve with rest or cessation of near activities? (Resolution of ocular symptoms after rest suggests true asthenopia.)
- Previous ocular signs or treatment (past history of ocular conditions may help in understanding current symptoms and establishing a referral pathway)
- General ocular requirements, including whether at school or studying, indoor vs. outdoor work, work or study environment (to assess possible contribution of vision problems, such as uncorrected refractive error, poor ergonomic or lighting conditions)

TABLE. RISK STRATIFICATION OF PATIENTS WITH EYE STRAIN SYMPTOMS

Assessment step	Low-risk features	High-risk features
Current history	<ul style="list-style-type: none"> Discomfort after reading Epiphoria or tearing with extended near work Mild dry eye symptoms increasing with near work Transient diplopia after extended near work Recent history of presbyopia (reading glasses) 	<ul style="list-style-type: none"> New-onset headaches Accompanying neurological signs (e.g. associated history of muscle fatigue) Recent decrease in vision Constant or increasing diplopia
Past medical history	<ul style="list-style-type: none"> History of convergence treatment 	<ul style="list-style-type: none"> Trauma Significant coronary disease Diabetes mellitus Cancer Recent change of medication
Ocular examination (GP)	<ul style="list-style-type: none"> Convergence insufficiency Refractive error Intermittent blur when reading 	<ul style="list-style-type: none"> Signs of inflammation (chemosis, conjunctival or limbal redness) Reduced or distorted vision at near or distance Intermittent or constant diplopia at near or distance Extraocular muscle palsy
Physical examination (GP)	—	<ul style="list-style-type: none"> Muscle weakness Clinical signs of giant cell arteritis Significantly raised blood sugar level Very high or low blood pressure

onset and precipitating and alleviating factors, the patient's hydration status and any history of syncope or trauma.

Physical examination of patients with headache should include:

- assessment of vital signs, especially blood pressure
- neurological examination, including fundoscopy
- a systems review.

Investigations such as a full blood count, multiple biochemistry analysis and thyroid function tests are needed to exclude more serious or potentially reversible abnormalities, such as anaemia, renal or hepatic disorders, electrolyte imbalances or thyroid dysfunction. Measurement of erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) level is important to diagnose temporal arteritis or other inflammatory conditions. If the ESR or CRP level are within the normal range but temporal arteritis is still suspected then a biopsy of the temporal artery should be arranged. If

headaches are severe and persistent or pathology is suspected, then CT or MRI scanning may be indicated.

Identifying the cause of eye strain

In patients with suspected eye strain, the next step is to identify the underlying cause. Diagnosis of a single contributing factor can be difficult and may require a multi-disciplinary approach. However, the GP is ideally placed to assess the contribution of individual factors, including general health and possible psycho-social concerns, as described previously (Box 3).

Visual history

The history from a patient with eye strain symptoms should cover eye use, near tasks, hobbies, screen time, and work and school ergonomics and environments. In children, it is important to ask where they sit in the classroom and to establish whether they have difficulty seeing the blackboard or their books at near distance. It should be kept in mind that as children

get older their screen time usually increases. In older patients, occupation is an important consideration. Does the patient work in an office or outdoors? Screen time, airconditioning, sunlight and reflective environments are all important factors to establish.

For a GP suspecting an eye strain-related problem, it is essential to ask about the duration of the problem or frequency of episodes to help establish a referral pathway. Questioning the patient about a personal or family history of refractive error, strabismus or eye treatment is important, as decompensating binocular conditions can lead to a recurrence of ocular symptoms.

Vision assessment

Vision testing should be routine in a patient with headaches or eye strain. Visual acuity charts are accessible to most practitioners, and reduced unaided or corrected vision can be easily identified. Patients should ideally be assessed with their

4. A UNIVERSITY STUDENT WITH HEADACHES AND EYE FATIGUE

Presentation

Linda, a 21-year-old university student, presents to her GP with intermittent headaches, eye fatigue and difficulty focusing her eyes over the previous several months. She is currently in her final year at university. The headaches are worse at the end of the day. She does not take any medication for them as they disappear with rest.

Assessment

Linda considers her general health and diet 'OK'. On questioning, she reports she has never worn glasses but was given eye exercises as a young child, although she was 'never great' at following them.

The GP checks Linda's visual acuity, which is 6/6 unaided in each eye. Convergence appears reduced, with Linda unable to converge her eyes past 25 cm.

Should Linda be referred for a further eye examination?

Linda has a history of eye exercises suggesting previous extraocular muscle weakness. Reduced convergence and recent symptoms coincide with an increase in visual stress (final year university), indicating a likely ocular origin.

Management

The GP refers Linda to an ophthalmologist. Examination confirms good visual acuity and no concurrent refractive error or ocular disease. However, her convergence near point is significantly reduced compared with normal.

She is treated with orthoptic exercises to strengthen her convergence and binocular function. At eight-week review, her ocular convergence is improved, and she reports her symptoms are significantly reduced.

current prescription if they wear glasses or contact lenses, at the correct distance and using one eye at a time. Vision improvement with the aid of a pinhole occluder can suggest uncorrected refractive error, or if optical aids are used, refractive progression. Patients with reduced vision should be referred promptly for ophthalmic assessment.

Convergence can be tested by asking the patient to focus on a target such as a pen or a fixation image that is held at arm's length and then slowly moved towards the patient's nose (Figures 1a and b). The near point of convergence occurs when the patient can no longer direct both eyes together on the target or describes double vision (Figure 1c). A near point of 20 cm or less is poor and may lead to eye strain symptoms. A more detailed ocular examination is appropriate at this point.

Referral

In patients with headache, referral for a formal eye examination is required to rule out significant ocular pathology, including glaucoma or papilloedema. Additional ocular causes, including ocular motility or refraction changes, will also be explored at this visit. Patients with reduced unaided or best corrected visual acuity should also be promptly referred for ophthalmic assessment.

Patients with true eye strain (primary symptoms of discomfort or difficulty in

working at near distance) will also benefit from a full ophthalmological examination. Although referral is still recommended in these patients, the absence of neurological or visual impairment suggests follow up is not urgent.

However, if symptoms or signs suggest a general health or neurological problem then referral for specialist assessment should not be delayed.

Treatment of eye strain

For patients who are diagnosed with eye strain, identifying the contributing factors allows treatment options to be prioritised. Case histories of two patients with eye strain and their management are shown in Boxes 4 and 5.

General measures

General health and stress-related causes should be treated according to standard practice, which may include medication or counselling. As eye strain may contribute to reduced learning and school performance, discussion with school representatives may occasionally be warranted for younger patients.

The role of supplementary vitamins in relieving eye strain symptoms is unclear. Omega-3 vitamins and bilberry extract have been found to reduce eye discomfort and ocular fatigue.^{23,24} This may be through improving the tear film or may reflect a previously suboptimal diet.

Ocular treatments

An uncorrected refractive error or ocular dysfunction should be treated by an ophthalmologist, optometrist or orthoptist, as appropriate. Convergence or accommodation exercises that improve the patient's functional ocular reserves can provide benefits relatively quickly in appropriate patients.

Treatment of dry eye symptoms should be based on severity and clinical signs and titrated to the individual. This will be determined in consultation with the ophthalmologist. The use of preservative-free tears is preferred to avoid an allergic response and possible exacerbation of symptoms. Low-level dry eye symptoms generally resolve quickly with supplementary treatment. If symptoms do not improve or deteriorate then prompt referral is essential.

Ergonomic measures

Ergonomic assessment of the work or study environment may be beneficial when indicated by the patient's history and occupation. The use of polarised computer screens, blue-blocking filters and curved monitors may help visual fatigue.²⁵ The positioning of monitors is important. The light source should be adequate without significant glare and ideally should be directed from behind the user to avoid direct glare.

The distance and height of computer

5. A MIDDLE-AGED MAN WITH SORE EYES, HEADACHES AND RASH

Presentation

Jack, a 58-year-old operations manager, presents with recent-onset headaches, 'burning' eyes and a skin rash. Physical examination shows patches of mild eczema around his neck and arms. His blood pressure is elevated compared with previous visits. He has no history of allergies and reports that his recent annual eye check with his ophthalmologist was 'clear'.

What might be causing Jack's symptoms?

Further questioning reveals that Jack's eye symptoms are intermittent, relatively nonspecific and variable in intensity. Although the history and recent ophthalmology visit suggest minimal ocular involvement, the development of headaches warrants a full medical history and examination, including eventual ocular investigation. A range of conditions, including raised intracranial pressure, are excluded (Table 1). A full blood count shows no change from previous results.

Management

During the physical examination, Jack mentions that his employer has been discussing possible redundancies. His wife was recently in hospital, although her condition appears to be improving. You talk to Jack about general anxiety and offer a referral for counselling as well as medication to alleviate the rash. You also suggest he tries using preservative-free artificial tears for the ocular symptoms. You recommend he returns for a review in six weeks, or earlier if necessary.

Review

On review after six weeks, Jack appears much more relaxed, as his work issues have been resolved and his wife's condition continues to improve. He says he is sleeping better, no longer has headaches, and the eczema has almost disappeared. His eyes feel fine. You provide reassurance and continue to review him at standard intervals.

monitors can also be optimised to reduce musculoskeletal concerns. The optimal viewing distance for most people is about 75 cm from the monitor, with the upper edge of the monitor about 15 cm below eye level (Figures 3a and b). However, this is a general guide and may need to be modified for additional factors such as a requirement for glasses, particularly reading glasses or multifocal lenses.²⁶ Consideration of font size may also be appropriate.

As computer users are at greater risk of dry eyes, patients should be encouraged to blink frequently and to take short

breaks from their device. Advice on viewing distance for smartphones or handheld devices may be helpful; a minimum distance of 30 cm is generally recommended, although this may be modified according to patient age.

Conclusion

It is likely that most people will experience eye strain symptoms at some stage of life. These symptoms can have a considerable impact. The underlying cause may be difficult to diagnose, and patients require assessment to exclude

serious underlying disease and identify possible contributing factors. GPs are well placed to guide the care and referral pathway for patients with eye strain symptoms, although assessment by an ophthalmologist or, if necessary, a neurologist must be considered when appropriate. MT

References

A list of references is included in the online version of this article (www.medicinetoday.com.au).

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