VISUAL FATIGUE

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__SUMMARY

Symptoms of discomfort are common among patients who spend considerable time performing tasks at near viewing distances – such as is common among computer users. Although the symptoms can be vague and seem elusive, they can usually be eliminated or reduced by diagnosis and treatment of the work arrangement and the visual system – including proper spectacle correction of presbyopia. This article summarizes clinical management of vision-related discomfort.

__BACKGROUND

Many of our patients have symptoms of discomfort associated with performing near tasks. Of course, the most common tasks performed at near involve reading – especially at computer displays [1]. Therefore it becomes the task of the practitioner to diagnose the conditions causing the symptoms and to devise a treatment plan to eliminate or at least mitigate the symptoms.

The reading task itself, whether on hard copy or electronic display, is perhaps the most visually-demanding near task. Typical reading involves a series of 200 ms fixations sandwiched between 35 ms saccades – each saccade moves the eyes 7-9 characters further in the text. Although this is very demanding, we have discovered that it is the cognitive uptake system that limits reading speed in subjects with vision systems that are performing well – not the visual system. By manipulating the text size and legibility we have noted that fixation durations and frequency are altered, but the reading speed is maintained [2-5]. Actually, it is remarkable that many people can read for hours with no symptoms.

Given that reading (near work) can be performed without symptoms under good conditions, it becomes our task to identify the reason(s) why our particular patient has symptoms of discomfort. I have observed clinically [6] and in laboratory research [7-9] that symptoms may occur when either the environmental conditions or the visual system capabilities are compromised. Resolving the patient symptoms often requires analyzing both the visual system and the environmental conditions under which they have the symptoms of discomfort [10].

__DIAGNOSIS

Analysis begins with scrutiny of the patient symptoms. This can often directly lead the clinician to the correct diagnosis. The symptoms can be categorized into visual, musculoskeletal, and asthenopia as shown in Table 1.

Symptom category	Symptoms
Visual symptoms	Blur at near
	Post work blur at distance
	Slowness in focusing
	Double vision
Musculoskeletal symptoms	Neck and shoulder ache
	Back ache
	Sore wrist
Asthenopia	Headaches
	Eyestrain
	Eye fatigue
	Ocular dryness
	Glare sensitivity

TAB. 1 | Three primary symptom categories

__VISUAL SYMPTOMS

Visual symptoms are the easiest to diagnose. They can easily result from an uncorrected refractive error – errors as low as 0.50 DC (Diopter Cylinder) can result in symptoms.

Presbyopic patients should be properly corrected for the unique viewing distance of their computer, and will report blur or musculoskeletal ache if not. Typically presbyopic patients require an intermediate prescription in order to see their computer correctly. It is important to determine the distance at which they view their work (office computer displays are typically at a viewing distance of 50-60 cm). Demonstration and refinement of the near addition in free space can reassure both clinician and patient.

Slowness in focusing, or distance blur after near work, is typically due to accommodative infacility. If so, tests of accommodative function can assess if this is a problem. It is best to test accommodative infacility directly using +/- lens flippers.

Double vision (diplopia) is infrequently reported, but indicates a binocular vision difficulty when present. An intermittent diplopia usually indicates an intermittent strabismus. Analyze the binocular vision system to determine if there is an eso or exo strain on the visual system. The most common problem is a convergence insufficiency that causes intermittent exotropia at near distances.

__MUSCULOSKELETAL SYMPTOMS

Neck ache and back ache are quite common in computer-using patients. This can often be due to inappropriate location of the display or inappropriate spectacle correction of presbyopia.

The top of the display should be near eye level. If not, then adjustments need made to accomplish this. Our visual system has a strong preference for looking down about 10 degrees – i.e. depressing the eyes about 10 degrees [11]. If the display center is not about 10 degrees below the eyes, then neck and back adjustments are made [12] resulting in strain.

Neck and backache can also be caused by presbyopia-correcting spectacles that cause an awkward viewing distance or posture to see the computer display or other uniquely-located near work. It is very common for general-issue bifocals or progressive addition lenses (even though they might work for most other everyday tasks) to be guilty of this.

Wrist, back, and shoulder pain or ache can also be caused by other work-related factors and referral to a workplace specialist is indicated.

__ASTHENOPIA

Asthenopia is a catch-all for the less-specific symptoms such as eyestrain.

Our research has repeatedly shown [13-14] that these symptoms fall into 2 constellations both subjectively (i.e. patient sensations) and objectively (i.e. the inducing condition). We call these 2 constellations "external symptoms" and "internal symptoms". They are summarized in Table 2.

In general, the differentiation can be summarized as follows:

• External symptoms – dry eye and caused by environment
• Internal symptoms – felt inside the eye and caused by visual conditions

The clinician can use this symptom differentiation to help guide the diagnosis and management of the patient. External symptoms indicate a dry eye condition and possible environmental culprits such as lighting, display location, or text quality. Internal symptoms indicate an ophthalmic or visual problem related to accommodation, convergence, or refractive error. Clinicians may want to use the clinical tests shown in Table 3 to diagnose accommodative and binocular vision disorders.

__PATIENT TREATMENT AND MANAGEMENT

After diagnosing the reasons, either environmental or visual, that cause or contribute to the symptoms of discomfort, then the appropriate treatment measures from those below can be used to treat the patient.

__FITTING THE PRESBYOPE

To begin, the location of the primary work (e.g. computer display) must be determined. If a computer display location can be altered, then it should be located so that the top of the display is level with the eyes. If the display cannot be located differently, then its location should be noted and spectacles designed accordingly.
Most younger presbyopes (near add of 1.25 D or less) can often use their regular bifocals or PAL for their intermediate work (e.g. computer display). This is because such patients have enough remaining accommodation that they are able to comfortably view and focus upon the intermediate task through the distant portion of their spectacle lenses.

Presbyopic patients with a near add of 1.50 D or greater often require separate spectacles for performing near work comfortably if that near work is at a unique viewing angle or distance, such as commonly occurs at computers or on assembly lines. If the patient wears bifocals for everyday needs, then it is likely best to provide the patient with work-related bifocals in which the top contains the intermediate prescription and the bottom contains the near prescription. Trifocals may be considered. If the patient wears PALs for everyday viewing, then it is best to provide Occupational Progressive Lenses (OPL) for the patient. OPLs are designed to provide extensive intermediate and near viewing areas. Usually the top of the lens also contains a small add of +0.50-0.75D. OPLs are very useful for most office and other indoor activities.

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	Symptom sensations	Perceived location	Inducing conditions
External symptoms	Dryness	Bottom of Eyes	Decreased blinking
	Burning	Front of Eyes	Overhead light glare
	Irritation		Upward gaze
			Small font
			Flicker
Internal symptoms	Strain	Behind the Eyes	Accommodative stress
	Ache	Inside the eyes	Convergence stress
	Headache		Astigmatic refractive error

TAB. 2 | External and internal symptoms

	Clinical test	Findings
Accommodation	Positive and negative lens to blur (NRA and PRA)	NRA and PRA should each be 1.50D or greater
	Accommodative flippers (+/-1.50D)	Expect 13 cycles/min monocularly, 10 cycles/min binocularly
Binocular alignment	Phoria	Any esophoria may be a problem. Exophoria less than 6 PD is seldom a problem. Otherwise, see Sheard's criterion
	Sheard's Criterion – base-out prism to first blur divided by the phoria. Only effective for analysis of exophoria [15-16]	Prism-to-blur should be twice the amount of the phoria.
	Near Point of Convergence	Should be easily repeatable and closer than 8 cm. Note if patient has subjective difficulty in performing test.

TAB. 3 | Tests for accommodation and binocular alignment

→ **In prescribing adds and designing** spectacles, it can be very useful to demonstrate the add and clear viewing distances in free space. If prescribing an OPL, it is also very useful to demonstrate the small distance blur through the top of the OPL so that there are no surprises at time of dispensing.

__DRY EYES

Dry eye is a common complaint among office and computer workers. Very often the following conditions contribute to dry eyes and fixing them can improve the symptoms:
1. Lower the computer display – especially if the top of the display is above the eyes.
2. Reduce or eliminate glare from the patient's field of view (see *Lighting* here after)
3. Correct refractive errors including presbyopia.
4. Make sure the text is not too small or viewed from a larger-than-normal distance. Most text should be 10 to 12 point in size, viewed with 100% screen magnification, and viewed from no more than 60 cm.
5. Eliminate any air drafts in the workers space.

In addition to the above measures, it is advisable to provide artificial tears to be used only as needed. Counseling about work breaks and light rubbing of the lids may also be helpful. More severe cases of dry eye require additional measures such as punctual plugs.

__ACCOMMODATION AND BINOCULAR VISION

Reduced amplitude of accommodation (for the patient's age) and accommodative infacility can both be managed with either orthoptic training or prescription of plus lenses (usually +0.50 to 1.00D) for near work. Working patients often are unwilling to spend the time with an orthoptic program, and the plus lenses can cure the problem.

Likewise, patients with esophoria at near are best treated with a near add, which reduces the eso stress on their binocular system. Patients with exo deviation**,** as often accompanied by convergence insufficiency, must be treated with orthoptics – lenses are not an effective treatment. Fortunately, convergence is the most easily trained visual function and can often be managed with push-up training alone.

__LIGHTING

Lighting is likely the most common environmental culprit insofar as causing and contributing to visual discomfort. All patients with near viewing symptoms should be counseled about eliminating glare from lights.

The most common lighting problem is shown in the picture below: light from luminaires (or windows) directly impinging the eyes of the patient – i.e. the light source is very bright in the peripheral field of the patient. This can be demonstrated to the patient by taking the patient to an office location with a bright overhead light, and requesting the patient to shield their eyes from the offending light with their hand. Patients should be encouraged to note the improved comfort by doing so. The patient can then be instructed to repeat the test at their work place to test if lighting is a problem.

If lighting is determined to be a problem, then possible interventions include: turning off the offending light, use blinds or drapes on windows, remove white surfaces, use partitions, rotate the work station, use indirect lighting, or wear a visor.

__WORK ARRANGEMENT

For visual and musculoskeletal comfort, the work to be viewed most often must be directly in front of the person and located so that the person views it with eyes depressed at least 10 degrees and no more than 30 degrees. For computer displays, intended to be used with an upright posture, the top of the display should be at eye level, resulting in eye depression to view all elements of the display.

Upright posture while maintaining the normal convex curvature of the lower spine can be important to long term comfort. Arms should be supported by chair arm rests to avoid tension across the shoulders. Variable positioning, such as adjustable height desks and chair also can improve patient comfort. Vue

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