



EXCESSIVELY CLOSE WORKING DISTANCE

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Abstract

The phenomenon of excessively close working distance is reviewed. Twelve possible etiologies for this common symptom are offered, ranging from environmental stress through problems with visual efficiency and vision perception.

Key Words

Harmon distance, working distance, accommodation, vision symptoms

The optimal distance between the midpoint of the eyes and the target of regard during desk work is equal to the distance between one's own elbow and the knuckle on the middle finger.¹ When this Harmon distance is purposely reduced, an excessively close working distance (ECWD) results.

ECWD is a common symptom among patients with learning problems. Wold² found a 62.2% incidence of ECWD among a group of 45 children with learning disorders. In another group of 74 children with learning disorders, he found a 35% incidence when writing and a 19% incidence of ECWD when reading. In my own experience, ECWD is present in the majority of patients who fail tests of accommodation, vergence, saccades, pursuits, or visual perceptual-motor skills. ECWD may not be reported by patient, parent, or teacher in every case but my own observations during desk top testing or vision therapy indicate the incidence is more than half.

Griffin³ associates ECWD with accommodative excess. Hoffman and Rouse⁴ list ECWD as a symptom of difficulty in the accommodative system. Rouse and Ryan⁵ state that ECWD may be observed by classroom teachers when myopia and deficient accommodative facility are present. Birnbaum⁶ reports "... There is a tendency to pull reading material close under conditions of stress and tension, or when material is difficult and requires concentration." Greenspan⁷ demonstrated that a pre-presbyopic nearpoint

convex lens prescription that is excessive can lead to ECWD.

This paper will describe 12 possible etiologies for the symptom of ECWD. The clinician encountering patients with this ubiquitous symptom may then be better prepared to diagnose its cause and devise an appropriate treatment plan.

Visual Acuity

ECWD enlarges the angular subtense of print on the retina and thereby enlarges the Snellen equivalent of the print. If the print is smaller than one's visual acuity threshold, adopting ECWD may raise the print above threshold.

Refractive

The bilateral or unilateral myope whose farpoint of vision is closer than the Harmon distance will demonstrate ECWD during desk work without compensatory lenses in place. Some clinicians have observed ECWD when uncompensated hyperopia is present.

Nearpoint Stress

Skeffington,⁸ and later Flax⁹ and Birnbaum,¹⁰ described in great detail the inherent stress of prolonged uninterrupted nearpoint work. Stated succinctly, sympathetic arousal during desk work drives accommodation beyond the target so that extra accommodative effort is required to maintain accurate accommodation. The extra accommodative effort drives convergence in front of the target so that an esophoric posture results. In this model, convergence is the motor aspect of the

entire process of centering. As a way to satisfy the drive to center closer to the target, the individual may adopt ECWD.

Highly Central Visual Information Processing

Macdonald¹¹ and Forrest¹² described central visual processing, peripheral visual processing, and the relationship between them. Forrest¹² describes the highly central "eso" processor in this way: "He tends to be good on a central basis and inferior on a peripheral basis ... and will constrict periphery, and even suppress one macula if needed in order to achieve it." Consistent with this model is the highly central "eso" processor who habitually adopts ECWD to attenuate his periphery.

Interruption of Binocular Vision

An individual with inadequate vergence skills may employ strategies that result in monocular vision as a way to relieve the burden of maintaining binocular vision. Adopting ECWD may aid the individual's attempt to interrupt binocular vision in three ways.

First, the patient with a receded nearpoint of convergence (NPC) can move the object of regard closer to gain a working distance that is closer than his or her NPC. In doing so, one eye will diverge relative to the plane of regard and suppression may be activated, resulting in monocular vision. Second, ECWD combined with a head turn can yield monocular vision. The closer one is to the target the fewer degrees of head turn required for the nose to occlude one eye. Third, direct attempts to occlude one eye by the individual may result in ECWD. For example, leaning the head on the palm of one hand so the open palm covers an eye results in monocular vision and ECWD. Also, laying one's head on an arm yields ECWD and monocular vision.

Central and Peripheral Fusion

Copper et al.¹³ described the rules by which motor fusion responds to central stimuli or peripheral stimuli. Peripheral motor fusion will dominate central fusion when the peripheral target is uniform and surrounds the central target completely. A wall behind a VDT, for example, may be a strong enough peripheral stimulus so that central motor fusion on the VDT characters is disrupted. Adopting ECWD can break up the uniformity of the wall and render it incomplete as a visual stimulus.

In this way ECWD may eliminate a conflict between peripheral motor fusion and central motor fusion.

Deficient Saccades

An inaccurate saccade during reading results in a fixation pause at a place not anticipated by the reader. The reader may become confused and shift his eyes back to the prior fixation pause to regain his place. Adopting ECWD compensates for frequent inaccurate saccades because the eyes stray less far from the prior fixation, the closer the person is to the text (assuming a constant saccadic angular magnitude). Effectively, ECWD reduces the length of text covered during one saccade so that the fixation pauses are closer together within the text. ECWD aids another compensation for poor saccades—head movements. Head movements are often used by individuals with poor control of saccades to minimize loss of place at the expense of reading rate. An ECWD requires larger head movements to cover the same linear span of text and larger head movements are easier to control and plan than smaller head movements.

Accommodative Excess

An accommodative response that is greater than the accommodative demand represents a specific type of accommodative dysfunction known as accommodative excess or lead of accommodation. This vision problem may be primary or it may be secondary to a convergence problem where excessive accommodation is used to obtain accommodative convergence to compensate for inadequate fusional convergence. For some individuals, ECWD may alleviate accommodative excess. At a certain target distance that is less than the Harmon distance, the lead of accommodation may change to a neutral or lag posture. Clinical evidence for this relationship is nearpoint retinoscopy, which shows a change from "against" motion (accommodative lead) to "with" motion (accommodative lag) at a distance closer than the Harmon distance in these individuals.

Visual Figure-Ground

Visual figure-ground is a visual perception skill that is important in academic learning.^{14,15} A patient with inadequate visual figure-ground perception may use ECWD as a way to eliminate background while retaining figure and thus minimize

the impact of his/her visual perception problem.

Span of Perception

Speed and span of perception are the duration of a fixation pause while reading (speed) and the number of characters that can be seen clearly and identified during a fixation pause (span). For a good reader a 250 msec fixation pause and eight character span are common.¹⁶ An individual unable to process eight characters at once on a perceptual level can reduce the number of characters fitting into the span by using ECWD.

Visible Persistence

Visible persistence refers to the continued perception of a stimulus after it has been physically removed.¹⁷ The duration of visible persistence is usually in the range of 200 to 300 milliseconds for the foveal targets viewed during reading. In reading, fixation pauses are separated by saccades. A typical saccadic duration is 25 milliseconds. It is possible, therefore, that the letters viewed during a single fixation pause could continue to be perceived into the next fixation pause because of visible persistence. In other words, visible persistence is longer than the time required for a saccade. This problem is normally overcome by inhibition of visible persistence when a saccade begins.

The duration of visible persistence is dependent upon the spatial frequency of the targets viewed.¹⁷ Visible persistence duration decreases with decreasing spatial frequency for normal readers. ECWD decreases spatial frequency by increasing the angular size of the print being viewed. Thus, ECWD can decrease the duration of visible persistence. This decrease in visible persistence would aid the reader with a temporary or chronic difficulty in inhibiting visible persistence in the normal manner.

Environment

Harmon¹ described in great detail the proper work environment for close visually-centered tasks, such as reading and writing. His descriptions concentrated on work surface, seating and lighting. If any or all of these are improper, the individual will alter posture to minimize the stress of the improper environment. In this situation, ECWD is not due to a visual problem per se. ECWD is one of many possible postural alterations undertaken to balance the body and vision with the task.

Diagnosis of ECWD Etiologies

A practical diagnostic approach (see Table 1) when a patient presents with ECWD would be to ask about the work environment during the case history where two of the etiologies of ECWD may surface. Next, rule out visual acuity or refractive problems. Visual efficiency skills account for four possible etiologies of ECWD and they should be considered if a satisfactory diagnosis is not gleaned from the case history, refraction or visual acuities. Finally, visual perception, accounting for the remaining four etiologies, should be investigated.

Treatment

Treating the underlying etiologies usually resolves ECWD. Treatment may simply be patient education on proper work environment in some cases. Prescription lenses and/or vision therapy may be appropriate in other cases.

I have observed recalcitrant ECWD in some of my patients after appropriate treatment has been given and all aspects of vision test satisfactory. It is possible that some of the ECWD etiologies are permanent and not amenable to current diagnostic and treatment strategies available to the optometric clinician. Visible persistence, for example, can be tested in a laboratory but is not routinely tested by clinicians. It is not clear yet whether faulty inhibition of visible persistence is amenable to treatment. The affect and cognitive style of the patient contribute to the nearpoint stress and highly central visual information processing etiologies of ECWD. These psychological factors may not be diagnosed or treated directly by the optometrist. Birnbaum¹⁸ raises this possibility and provides suggestions for optometric management.

Conclusion

While ECWD may be effective in compensating for certain vision or environmental problems, it is certainly not a desirable posture for nearpoint visual activities. Habitual use of ECWD may lead to permanent vision problems, notably myopia.^{19,20,21} The musculo-skeletal elements of the head, neck and upper back may suffer, too.^{22,23} When an abnormal posture such as ECWD is adopted, muscles are tighter than normal and blood flow to nearby tissues is constricted. Reduced blood flow can irritate the muscles so that

TABLE 1.
Etiologies of ECWD grouped by aspect of vision and suggested testing sequence.

I. Environment	1. Aberrant work surface, seating or lighting
	2. Central vs. peripheral fusion
II. Basic Vision	3. Visual acuity
	4. Refractive
III. Visual Efficiency Skills	5. Nearpoint stress
	6. Interruption of binocular vision
	7. Deficient saccades
	8. Accommodative excess
IV. Visual Perception	9. Visual figure-ground
	10. Span of perception
	11. Visible persistence
	12. Highly central visual information processing

abnormal muscle tension persists after normal posture is assumed. If an abnormal posture is adopted repetitively, ligament and bone injury may occur.²³ Finally, the task at hand is accomplished less efficiently if the individual deviates from the Harmon working distance. The patient presenting with ECWD deserves consideration of all possible etiologies so that appropriate treatment can be instituted.

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