Visual & Ocular SYMPTOMS

RELATED TO THE USE OF VIDEO DISPLAY TERMINALS

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Abstract

Eyestrain or visual fatigue represents the single largest category of health complaints related to the use of video display terminals. Characteristics of the display itself, as well as ergonomic factors related to the design of the workstation, are the greatest causes of these visual difficulties. While there is little scientific evidence that VDTs lead to any permanent visual damage, knowledgeable optometric intervention can prevent or significantly reduce many of the visual symptoms related to VDT use.

Key Words

video display terminal, VDT, eyestrain, visual fatigue, workstation, ambient illumination, display luminance, persistence rate, refresh rate, flicker, specular reflection, diffuse reflection, ionizing radiation, nonionizing radiation, ergonomics

It has been predicted that by the beginning of the second millennium, 75% of all jobs will involve computer use.[1] The recent expansion of computers in the workplace has resulted in a growing number of health complaints from employees using video display terminals (VDTs). These health complaints range from headaches and visual fatigue to musculoskeletal strain involving the neck and back.

Since more and more offices are becoming computerized, the likelihood of an increase in the number of health-related complaints, because of a lack of legislation mandating standards for VDT use, is great. Prolonged VDT use has been implicated in a variety of health problems ranging from carpal tunnel syndrome to miscarriage.

In the early 1980s it was estimated that there were somewhere between seven and ten million people in the United States who worked with video display terminals.[2]

Joel Makower stated that the wide range of "problems associated with VDT use ... (are) due partly to the 'ergonomics' (design) of the machines, and partly to the way in which they are used."[2]

When the New York Committee for Occupational Safety and Health (NYCOSH) convened a conference aimed at workers who had experienced health problems related to VDT use, hundreds of people appeared, with many being turned away due to a lack of space.[2]

Dr. Olov Ostberg, a pioneer in the field of technology health science, warned both manufacturers and operators of modern day office equipment, such as VDTs, to pay close attention to the early signs of any problems that, if ignored, could potentially result in occupational illness.[2] Unfortunately, it seems that Ostberg's warnings have, for the most part, gone unheeded.

One federal government study on the health-related aspects of VDT use included its effects on the visual system. Effects of computer use on the human visual system have been categorized to include burning eyes, blurred vision, eye strain, and changes in color perception.[3]

The National Institute of Occupational Safety and Health (NIOSH) presented some recommendations regarding VDTs and vision.[3] The American Academy of Ophthalmology (AAO) and NIOSH agreed that a need existed for flexibility in lighting and equipment adjustment. NIOSH took its recommendations a step further by stating that VDT operators should receive visual testing prior to beginning VDT work and should be monitored on a fairly regular basis thereafter to ensure maximally correct vision.

In 1981 the National Research Council (NRC) Committee on Vision created a Panel on the Impact of Video Viewing on Vision of Workers. These panel members, from various scientific and technical areas, reviewed an extensive literature, including various field surveys and laboratory studies. The panel realized early in its investigation that visual issues related to VDT use had to be "considered within the larger context of the working environment, including the quality of VDT workstation equipment, job designs, and workers' concerns and needs for information."[4]

A report prepared for the Wisconsin Department of Administration by Steven L. Sauter of the Department of Preventive Medicine at the University of Wisconsin

focuses on both visual and musculoskeletal aspects of VDT use.[5]

Sauter's report is comprehensive in its coverage of common complaints related to VDT use such as job stress, musculoskeletal and visual strain. The report also covers ergonomic factors such as illumination, display quality, workstation design, and includes checklists for work tables and chairs.

Ergonomics has been defined as the "aspect of technology concerned with the application of biological and engineering data to problems relating to the mutual adjustment of man and the machine."[3] It plays a significant role in numerous health complaints related to VDT use.

NIOSH has agreed with industrial engineers on several aspects of computer workstation requirements covering everything from lower back support to appropriate angles for line of sight.[3]

Legislation regulating VDT use and addressing the health concerns related to VDT use has been slow in coming. By 1989, 25 states had proposed legislation on VDT safety. Oregon's governor vetoed his state's bill. A Suffolk County, New York, law requiring employers to pay 80% of eye exam and spectacle costs for VDT operators was repealed.

In December 1990, San Francisco became the first municipality in the United States to pass legislation regulating VDT use. This law was in danger of being preempted by weaker state legislation, containing only "the bare minimum in terms of worker protection," which was presented to the California Occupational Health and Safety Standards Board in April 1991.[6] Since that time, the ordinance has been struck down by the San Francisco Superior Court.

VISION AND VDT USE

There seems, as yet, to be little scientific evidence that VDT use leads to any permanent visual damage. However, it has been reported that eyestrain continues to be the single largest category of health complaints among VDT users, with more than half of VDT operators experiencing eyestrain or some form of visual discomfort.[7] A study conducted in Singapore reported 94% of VDT operators suffering from visual complaints.[8]

Few researchers would argue that VDT tasks are not visually demanding and that, in some cases, existing visual problems may be exacerbated by prolonged VDT use. Yet many feel that VDT work requires no more from the human visual system than is necessary for many other occupations requiring close visual attention.[7] Nevertheless, most surveys, according to the National Research Council's Panel on Impact of Video Viewing on Vision, show that:

> more than 50% of VDT workers indicated ... some type of ocular discomfort (irritation, pain, or fatigue involving the eyes) or blurring or flickering of vision. In studies that included comparison groups of non-VDT workers, a majority have reported that complaints related to vision were more prevalent in the VDT subjects.[4]

There remains a great deal of debate over the relationship between eyestrain and visual function. The terms "eyestrain" and "visual fatigue" are often ambiguous. These complaints, also known as asthenopia, have become a "catchall description for various symptoms of visual discomfort, including burning, itching, tiredness, aching, soreness, and watering."[7] Some operators have reported a need for a change in their spectacle correction after a period of VDT work, while others have reported the need for a refractive correction for the first time.[7]

Vision comprises two basic types of activities. One involves the physical adjustments of the eyes in order to facilitate high quality and compatible retinal images. These adjustments include precise triangulation of the eyes on the object of regard, changes in pupil size, and changes in the curvature of the crystalline lens.

The second major type of activity involved in vision consists of perceptual and mental aspects. Adjusting to a new spectacle prescription, deciphering unfamiliar handwriting, or reading complicated instructions require perceptual and mental effort and may produce eyestrain.[5]

It is also known that the "development of eyestrain is dependent, in part, upon psychological or motivational factors."[5] These psychological and motivational factors often play a major role in many of the complaints of eyestrain and visual fatigue related to VDT use.

Physical Adjustments

Pupillary adjustments, lenticular changes, and precise eye movements require muscular effort. Since muscles fatigue and often cause pain when over exerted, it is conceivable that eyestrain may result from excessive use of parts of the adjustment systems.

Some propose that eyestrain related to VDT use results from stress to the pupillary control system.[9] It is suggested that the system can be stressed when there is a constant switching of fixation from a relatively dark display screen to a brighter source document, resulting in repeated constriction and dilation of the pupil. Changes in pupil diameter are controlled mainly by the sphincter of the iris, which is a non-striated muscle.[9] The striated muscles that control, for example, arms and legs are of a different nature and can indeed become easily fatigued to the point of resulting in painful cramps. This does not normally occur with non-striated muscle.[9] It is also not certain that the magnitude of pupillary changes that occur when working with a visual display terminal is enough to cause pain or discomfort.

The accommodative system may also be affected since the ciliary muscle, unlike the muscles of the iris,

> has an intermediate physiology between striated and non-striated muscle ... It is therefore conceivable that visual discomfort could arise from the hyperactivity of the ciliary muscle... However, there is no reason to suppose that, under a normal range of accommodative activity, this should occur.[9]

Long periods of near work can cause a decrease in the speed of refocus to distance.[5] This may result in temporary myopia due to prolonged periods of focusing at near that usually clears within a short period of time.

Mental Demands

Eyestrain is unlikely to occur in the course of normal daily visual activity when vision is a fairly unconscious automatic process. It is conceivable, however, that a conscious effort to see, particularly for long periods and under conditions that are less than optimal, may result in eyestrain. Attempts at deciphering illegible handwriting or poor copy, driving at night, or reading in low light can require conscious effort that can effect motivation.[5]

The quality of the retinal image is strongly related to illumination in the visual environment, contrast between the ob-

jects within that environment, and clear boundaries between those objects.[5] Eyestrain will result when these factors are inadequate.

High levels of motivation may help to slow the process of eyestrain. However, there are factors other than poor illumination or substandard copy quality that can sabotage even the highest levels of motivation. Visual tasks that lack variety can lead to boredom and decreased motivation resulting in an increased conscious effort and, inevitably, eyestrain. This is often the case of the VDT operator who spends several hours each day simply entering data.

REFRACTIVE CONDITIONS, OCULOMOTOR IMBALANCES AND VISUAL DISCOMFORT

Uncorrected refractive conditions and oculomotor imbalances may result in problems when the visual system is subjected to prolonged near work. Asthenopia can result from exerting continuous effort in an attempt to compensate for the refractive condition or oculomotor imbalances. Such asthenopic symptoms can also result from accommodative difficulties, convergence difficulties or fusional deficiencies. In some of these cases careful clinical examination, along with necessary refractive correction or vision therapy, helps to alleviate the causes of the asthenopia.

Refractive Conditions

Yeow and Taylor conducted a study on the visual effects of short term video display usage. They demonstrated that intermittent VDT use produced refractive changes no greater than those experienced by the subject group exposed to a normal work day without using a VDT. However, there was a statistically significant increase in mean refractive power after short-term continuous use.[10] This study suggests that the amount of time spent at a VDT and the distribution of that time are important factors in refractive changes. This study also showed that refractive changes noted after VDT usage seemed to be independent of the subject's individual refractive status. The changes were found to occur over a wide range of prework refractive conditions, producing statistically significant myopic shifts in myopes, emmetropes, and hyperopes.

In a study of VDT users conducted by the State University of New York, State College of Optometry, 91% of the subjects complained of eyestrain, 80.7% complained of blurred vision at near, 56.1% of blurred vision at distance, and 17.7% complained of diplopia.[11] The younger subjects reported blurred distance vision more frequently than older subjects.

Other studies have reported visual symptoms similar to those reported in the SUNY study including photophobia and colors surrounding objects being viewed.[12]

Oculomotor Imbalances

It is difficult to specify visual fatigue in measurable terms. Several researchers have attempted to monitor oculomotor function during prolonged VDT use with the hope of providing "objective correlates of visual complaints or even a physiological basis for those complaints."[4] Investigators have reported temporary changes in oculomotor function following VDT work. However, problems arise with the hypothesis that these temporary changes produce visual fatigue when other possible causes of the decreased motor function are considered. Physiological, as well as emotional stressors such as decreased motivation due to boredom, poor copy for display quality, or inadequate illumination, may very well play an important role in decreased motor performance.

Mourant, Lakshmanan, and Chantidisal stated:

> that printed material and CRT images differ in quality. CRT characters are relatively blurred and have small area flicker. Continuous action of the eye lens may be necessary to achieve proper focus on the relatively blurred characters. The small area flicker also necessitates constant adjustment ... to varying light levels. Close range viewing of VDTs requires convergence and accommodation of the eyes for sustained periods of time. The ocular muscles controlling eye movement are likely to be exerted beyond their capacity; long term, static muscular activation cannot be maintained if the exerted force exceeds 10% to 15% of the muscles' capacity.[13]

Blink Rate

There is evidence that the blink rate is affected by visual tasks requiring concentrated attention such as prolonged VDT work.

It has been shown that VDT use can produce a significant decrease in the normal blink rate.[14] This is usually caused by increased concentration on the part of the VDT operator who subsequently develops the habit of staring at the display screen. Reduced blinking can lead to a drying of the eye surface with a decrease in the oxygen supply to the corneal epithelium. Blinking, in addition to providing moisture, provides for the flushing of contaminants such as dust from the eye's surface. The electrostatic attraction of dust to the video display screen may further exacerbate the symptoms of dry and gritty eyes commonly reported by many VDT workers. Operators should be encouraged and reminded to blink frequently and take rest breaks to reduce the onset of these symptoms. This is particularly relevant in the case of contact lens wearers, when a decreased blink rate can result in deposit build up and drying of contact lenses, which may further lead to ocular insult.

VISUAL EFFECTS OF DISPLAY CHARACTERISTICS

There seems to be little argument regarding the effect of monitor design and display quality on visual performance. The NRC's study stated that:

> poor display quality ... probably contributes to the annoyance and discomfort sometimes reported by workers... Visual performance is affected by a number of display parameters, such as character size, structure, and style, and by image contrast and stability.[4]

Luminance

Various recommendations have been made with regard to luminance values for background and characters. Although the human eye is capable of adapting itself automatically in order to function efficiently at various levels of luminance and contrast, it has been suggested that an optimal screen contrast would be approximately 7:1, with characters having a "minimal luminance of 45 cd/m^2, and preferably between 80 and 160 cd/m^2."[15] Campbell and Durden have stressed, as have others, that "VDTs should have brightness controls available for the individual operator so that he can adjust the contrast from time to time depending upon the ambient lighting of the workplace."[9]

Contrast

Text contrast on video screens is displayed as either negative (light letters on a dark background) or positive (dark letters on a light background). The controversy over which is better continues to this day. It has been proposed that rapid changes in pupil diameter occur when a VDT operator constantly switches from light background hard copy to dark background display screen and can result in fatigue of the iris muscle.[9] Experiments inducing rapid pupillary changes rendered no such evidence. This seems to be because the pupillary response is controlled by a non-striated muscle and is innervated by the autonomic nervous system.[9]

Flicker

The characters produced by the cathode ray tube (CRT) are formed when phosphors inside the glass tube are powered by an electron beam. A gun at the rear of the tube shoots this beam toward the screen and the phosphors, which coat the inside surface of the screen, begin to glow when energized by the electrons. The beam moves across and down the screen at a fixed rate with the phosphor glow remaining for a short period after the beam has moved on. The time span of the glow is referred to as the phosphor's "persistence rate." The rate at which the screen is repainted by the electron beam is known as the "refresh rate." If the refresh rate is too slow or the persistence rate too short, the characters may appear to flicker on the screen. The point at which flicker becomes apparent varies from one individual to another and is known as critical fusion frequency (CFF). Since most displays are now manufactured with refresh rates between 50 and 60Hz, identifiable flicker is prevented for many operators when the screen utilizes negative image display (light letters on a dark background).[9] Positive image display screens require a higher rate since a larger area of the display is illuminated.

According to the NRC study, flicker is of particular importance because of its ability to induce epileptogenic seizures.[4] However, individuals prone to such seizures have experienced incidence only at extremely low refresh rates (8 to 14 Hz). The United States standard for refresh rates is well above that range.

Perceivable flicker has not been shown to result in a significant deterioration in visual performance. However, subjective reports such as annoyance, fatigue, and headache warrant displays devoid of apparent flicker as a matter of operator comfort since these complaints may well affect motivation. Some researchers suggest that green phosphors should be the standard since the eye is most sensitive to the 550 nm range of the spectrum.[15] It seems, for the most part, that phosphor color has little or no influence on physiological measures such as contrast sensitivity or visual acuity. The NRC reported "no known performance differences associated with differences in the color of the phosphor used. Attempts to measure performance differences have consistently resulted in no differences, as long as the blue and red extreme ends of the spectrum are not considered."[15] Acuity for the blue end of the spectrum is lower than for the rest of the spectrum since the fovea contains relatively few blue-sensitive cones.

Color

Multi-color displays may present another problem. Some operators may notice that certain colors appear closer than others, causing words or letters to apparently jump off the screen. In the majority of individuals, the fovea lies approximately 5 degrees temporal to the optic axis. Due to lateral chromatic aberration, different colors fall on different parts of the retina and are pereceived by the "normal depth-detecting mechanism, thus producing illusions of depth. It is not a physiological problem ... (and) usually becomes less noticeable with time."[9] This phenomenon can usually be alleviated by decreasing the color contrast or increasing the background illumination in order to desaturate the colors.

Display Character Qualities

Consideration of the quality of the display characters themselves should take into account the size, shape, and spacing in order to best enhance both legibility and readability.

The characters on a display screen are comprised of a series of dots (pixels) or horizontal lines (rasters) which blur together and are perceived as solid characters. The more dots or lines used to produce a character, and the less space between them, the more solid the character will appear. The pattern of dots or lines is called a matrix. A 7 x 9 dot matrix would be seven dots wide and nine dots high and is considered the minimum matrix to be used for text processing applications.[7]

While a raster written character has no horizontal spacing, a 7 x 9 dot matrix character would be equivalent to a raster-written character with a height of nine line segments.[5]

The shape of characters displayed on the screen can also effect legibility and readability. Square characters are usually seen with more ease. Upper case in combination with lower case letters are easier on the eyes than displays that provide only upper case letters.[2] Spacing between characters and lines also affects quality of the display and should provide for a minimum of a one-half character space between words and a one character space between lines.

One of the most common causes of character blur stems from operating the VDT at high levels of brightness and contrast. When these parameters are turned up, the electron beam increases in diameter as it sweeps across the inside surface of the screen and becomes slightly less focused. This leads to an increase in the size of the pixels with light spreading around the edges (referred to as "blooming"). The result is characters that appear blurred and out of focus.[5]

Reflection and Glare

Since most VDT screens are convex in shape, reflection and glare can often become a problem. Although neither of these problems can actually be blamed for producing any lasting visual dysfunction, they can be great sources of annoyance and possibly visual fatigue that may have a direct impact on the operator's motivation.

Video display terminal work requires lighting arrangements different from those used for typical office work. While there continues to be little agreement concerning standards for lighting levels required for VDT tasks, there are some general rules that can be applied. Glare may be one of the most common complaints of VDT operators, but it is also one of the easiest to correct.

It is generally accepted that lower ambient illumination is more desirable for VDT work than the brighter light normally used in most office environments.[2] It is also important to consider the placement of lighting sources with respect to the po-

sition of both the VDT screen and the operator's eyes. Lighting sources should be positioned to avoid reflecting directly onto the screen or into the operator's eyes. In the case of an office with lighting from windows, the screen should be placed at a right angle to the window and use of blinds and/or curtains will allow for easier control of background illumination. The same rules hold true for artificial lighting, which ideally should be shielded. Unfortunately, in most offices this is not the case. Fluorescent lights are usually mounted in the ceiling and shine "unremittingly down onto the work surface, often resulting in a glare problem."[2]

Eliminating glare greatly enhances visual comfort during VDT work. Providing matte finishes on all equipment and furniture, as well as floors, walls and ceilings, helps to minimize the reflection of light off these surfaces. Anti-glare filters fitted over the display screen will also provide for a reduction in reflected light.

There are several different types of filters available that can reduce reflection on display screens. The primary purpose of such a filter is to enhance legibility by improving contrast or reducing glare.

The neutral density filter is the most common type of contrast enhancement device. It consists of a tinted filter that transmits a portion of the ambient light (about 15% to 25%) onto the display screen. Specular, or mirrorlike, reflection (glare) may not be as effectively reduced by this type of filter as is diffuse (non-mirrorlike) reflection unless the surface is treated with an anti-reflective coating.

Directional filters prevent ambient illumination from hitting the VDT screen by utilizing geometric or optical means. One filter of this type acts as a small venetian blind. It uses tiny, embedded slots that lie perpendicular to the surface of the filter, thereby allowing light to travel only in certain directions. Orienting the slots toward the operator prevents overhead illumination from reaching the display screen and enhances contrast by reducing diffuse reflection. Specular reflection reduction would necessitate the addition of an anti-reflective coating.

Circular polarizer filters with an anti-reflective coating will effectively reduce both specular and diffuse reflections. This is one of the most expensive filters. The surface of the filter is coated with thin layers of optically transparent material. This type of filter reduces reflection in two ways. It reduces glare from ambient lighting by means of the anti-reflective coating and eliminates reflection from the VDT screen itself through the polarizer. This filtering process greatly improves display contrast.

VDT RADIATION AND CATARACT FORMATION

While there have been some claims in recent years that radiation emissions from VDTs have been responsible for the formation of cataracts, there is still little in the way of scientific evidence to support these claims.

Small opacities that do not affect vision are fairly common, showing up in as much as 25% of the population.[4] These opacities increase in frequency with age, having been found in 61% of the population between the ages of 75 and 85.[4] Some cataracts are congenital in origin, while those that develop later in life are often the result of trauma, metabolic or degenerative disorders, or exposure to high levels of radiation.

The various types of radiation distributed along the electromagnetic spectrum are divided into two groups: ionizing and non-ionizing.

Ionizing radiation, so called because it possesses enough energy to charge atoms and molecules, has the highest frequencies and shortest wavelengths as compared to the less active, longer wavelength radiations on the non-ionizing end of the electromagnetic spectrum.[7] The five types of ionizing radiation are alpha, beta, gamma, x-rays (hard and soft), and neutrons.

Ionizing radiation is known to cause cellular changes and can affect living tissue by breaking chemical bonds and charging neutral molecules.[7]

Visual display terminals neither produce nor emit alpha, beta, gamma or hard x-radiation. Although small amounts of soft x-rays are produced by the phosphors as they are activated by the electron beam, only insignificant amounts escape. Almost all of this radiation is contained by the glass display screen. No study has shown emissions of ionizing radiation from VDTs to be any greater than the background radiation levels that are found to occur naturally in the environment.[7]

Non-ionizing radiation does not possess sufficient energy to charge atoms or molecules or to break chemical bonds, but can cause rotation or vibration of molecules. The energy from this rotation or vibration is spent as heat and can therefore produce thermal effects.

Non-ionizing radiation, including ultraviolet, infrared, and microwave, may cause the formation of cataracts due to thermal effects induced by high level exposure.[7] Exposure of the eye to ultraviolet radiation above the Threshold Limit Value (TLV) can cause conjunctivitis, keratitis and cataract formation. Infrared radiation can cause damage to the cornea, iris, and lens. These effects are due to the heating of the eye. One well known adverse effect of exposure to high levels of infrared radiation is the heat cataract.[7]

At high levels, microwave radiation can produce thermal effects similar to those caused by ultraviolet and infrared radiation, causing a heating of the eye that can lead to cataract formation. Again, tests to determine the extent of microwave emissions from VDTs have found no measurable levels.[7] In addition, cataracts caused by radiation exposure have a very specific appearance, differing from those normally found to occur due to congenital defects or as part of the aging process. Cataracts caused by high levels of radiation occur on either the anterior or posterior surface of the lens capsule. Normally or spontaneously occurring cataracts appear within the lens itself. It is, therefore, fairly easy to determine, by thorough clinical examination, whether or not a cataract is the direct result of radiation exposure.

While certain types of radiation, such as ultraviolet, infrared, and microwave, are known to increase the chances of cataract formation due to thermal effects, the levels normally produced by VDTs are so low as to be considered insignificant. Some VDTs produce small amounts of ultraviolet and/or infrared radiation, but those levels are normally about 1/1000 of the accepted National Institute for Occupational Safety and Health (NIOSH) standards and, therefore, do not constitute a threat to the clarity of the crystalline lens.[7]

When two editors on staff at the New York Times claimed to have developed cataracts as a result of exposure to radiation emissions from VDTs, the Newspaper Guild became interested in the issue of VDT safety. This led to an extensive study

by NIOSH on levels of radiation emitted from VDTs. The study found all levels to be well below those known to produce biological effects.[7]

There are, however, investigators who have since become concerned with other areas of the non-ionizing end of the electromagnetic spectrum, particularly those frequencies comprising radio frequency radiation.[7] This group includes microwaves (although this frequency is often treated as a separate range), communications frequencies, very low frequencies (VLF), extremely low frequencies (ELF), and the power frequencies which carry electric current. It has become an issue of some controversy as to whether long-term exposure to these low-level types of radiation may produce physiological consequences.

Ergonomics and Vision

The design of the VDT workstation is every bit as important in considering the visual well-being of the operator as it is in considering his or her total physical well-being. It is difficult to separate some of the physical complaints related to VDT use from the vision problems. Although recent workstation design has incorporated a greater degree of flexibility, problems still exist.

Glare, if not properly reduced by the use of filters or changes in the working environment, may cause the VDT operator to make postural adjustments to compensate. This forced adaptation may result in neck or back strain and headaches.

Operators may find that their contact lenses or spectacles make viewing the display screen difficult unless it can be moved forward or backward. Reading glasses, prescribed for a distance of 16 inches, will sometimes prove inadequate for viewing a display screen two feet away from the eyes. Postural adaptation to compensate may again result in neck and back problems.

Operators wearing certain types of bifocals are at an even greater disadvantage. Unless the display screen provides operators with the ability to move the screen up or down, they are likely to be forced to compensate by tilting their head back in order to view the screen through the bottom portion of their lenses. Once again neck and back pain may result.

Many vision care professionals feel that special intermediate range prescriptions are necessary for some VDT operators. Since most reading or near vision prescriptions are based on a viewing distance which is closer to the eyes than most VDT screens, a correction prescribed for a slightly greater distance eliminates the need for physical adaptation to compensate, thereby alleviating some physical and visual symptoms.

SUMMARY

While researchers continue to search for definitions and measurements to describe and diagnose eyestrain and visual fatigue, several points concerning VDT work and visual complains remain clear.

A large number of VDT operators do experience symptoms of visual discomfort. Most of these complaints can be alleviated by proper vision care in the form of spectacle correction and/or vision therapy and by careful attention to ergonomics.

Certain ergonomic factors, such as workstation design and ambient illumination affect not only the visual system, but also the musculoskeletal system.

As the number of Americans using video display terminals as part of their workaday life increases, so does the need for well informed eye care professionals and paraprofessionals who can provide optimal service to their patients.

The first step in providing this care to the VDT operator involves the use of a case history adapted to the special needs of this patient population. Questions regarding VDT use should be incorporated into the normal patient history. Once a VDT patient has been identified, ergonomic issues also need to be addressed. Incorporating a patient questionnaire, similar to those developed by the Video Display Terminal Eye Clinic at the School of Optometry, University of California at Berkeley, will greatly aid practitioners in meeting the individual needs of the VDT operator. Such clinics also provide a simulated VDT workstation in order to aid in the diagnosis of VDT-related visual problems.

The growing number of VDT operators may eventually lead to greater employer responsibility for the health and safety of these employees, including the provision of occupational optical corrections specifically prescribed for VDT use and vision therapy. If such increased employer responsibility becomes reality, the number of VDT operators seeking care from eye care professionals will increase dramatically.

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