Hemianopsia and Falls Prevention

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Abstract

Vision plays a critical role in helping to maintain a sense of balance which is important in falls prevention. Any form of vision impairment including reduced visual field can heighten the risk of falls. This article outlines an interdisciplinary approach to the care of patients with hemianopsia. The article will provide vision rehabilitation professionals with a better understanding of prescribing prism systems, orientation and mobility training, and low vision rehabilitation techniques. In order to provide optimal services, an interdisciplinary approach to the care of patients with hemianopsia is essential in the success of low vision rehabilitation in falls prevention. The information contained in this article will focus on low vision services provided to adults with hemianopic visual field loss. Services at the Portland VA Medical Center Advanced Ambulatory Low Vision Clinic are provided by a low vision optometrist, certified low vision therapist, and orientation and mobility specialist. Others on the rehabilitation team include occupational, physical, speech, and kinesiotherapists. In other settings and with other populations, vision rehabilitation may be provided by trained professionals.

Keywords: prisms, visual field enhancement, visual field expansion, orientation and mobility, low vision rehabilitation

Introduction

Hemianopsia is a term that describes a loss of vision that affects half of the visual field of one or both eyes. This field reduction prevents the individual from seeing objects in half of the visual field. Any conditions or injuries affecting the visual field pathway may cause hemianopsia. These include stroke, brain aneurism, brain tumors, or traumatic brain injury. Occasionally people with migraines, extremely high blood pressure, or in conjunction with a seizure may also experience a transient form of hemianopsia. Other rare causes of the condition include infections such as encephalitis, brain abscesses, and Creutzfeldt-Jakob disease (Padula & Argyris, 2010).

Following the neurological event, individuals frequently lose their ambient or peripheral visual

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process and are left with a focal processing system that breaks up the visual world into isolated parts. This causes extreme difficulty with balance and movement. Another consequence of the incident is a tendency to compress and limit their spatial world.

Movement in a crowded environment becomes quite disturbing because the ambient or peripheral visual process is supposed to assist in stabilizing the image of the peripheral retina. Without this system the person internalizes the movement that he or she is experiencing in the peripheral vision. Disorientation and vertigo often persist and cause severe dysfunction, including falls (Padula & Argyris, 2010).

According to information from the Centers for Disease Control (Leukenotte & Conley, 2009), it has been estimated that the total direct cost of all fall injuries for people 65 and older in 2000 was more than $19 billion: $19 billion for nonfatal falls and $179 million for fatal falls. By 2020, the annual direct and indirect cost of fall injuries is expected to reach $43 billion (in current dollars) (Leukenotte & Conley, 2009). It is also reported that visual impairment is one factor for increase risk of falls in the elderly (Ramrattan et al., 2001). Because of this fact, intervention to prevent falls makes sense in cost savings in addition to contributing to the individual's well-being.

In the following sections, we will discuss types of visual field enhancement systems, and visual field expansion systems. Also discussed will be therapeutic techniques for training to be used by the low vision specialist.

Visual Field Enhancement

One approach to dealing with hemianopic visual field loss is the use of a field enhancement prism. There are subtle differences between the two systems. Visual Field Enhancement utilizes techniques to enhance the use of remaining functional vision, whereas Visual Field Expansion actually expands the visual fields using prisms.

Bell (1949) was one of the earliest writers to reference visual field enhancement for a patient with hemianopsia. A mirror mounted to a patient's frame reflects the image of an object on the nonseeing side to the functioning area of the retina. The mirror system is not widely used today as it has many disadvantages, such as producing a nasal scotoma, creating a reversed image, and involving tedious and time-consuming training (Brilliant, 1999).

Today, a prism system is more widely prescribed and accepted by patients with hemianopsia. A prism system is prescribed to move the image of an object in the patient's non-seeing area to the seeing area ($1\triangle = 0.57$ degree displacement).

The most commonly prescribed prism systems for visual field enhancement are sector and round prisms. A sector prism is a straight edged segment prism and a round prism is a round segment prism, 18 mm (3/4; inch) in diameter. The round prism was popularized by Gottlieb as the Rekindle™ System.

The type of ground-in prism (round vs. sector) prescribed will depend on the size of the patient's frame and the placement of the prism. Typically, a round prism is prescribed unilaterally on the temporal side of the lens as the nasal segment placement in the opposite lens may not meet the clearance criteria. In addition, prescribing a round prism in both lenses may induce diplopia when the patient is looking through both prisms. Patients with bilateral sector prisms may also experience diplopia therefore it may be necessary to prescribe the prism unilaterally. This will be determined during a trial period with Fresnel press-on prisms.

Normally, Fresnel press-on prisms (available in 0.5 to $30\triangle$) are prescribed and tried first to determine the effectiveness before ordering ground-in prisms in the spectacle which provide a clearer view of their missing field. This temporary prism usually needs to be replaced every 3 months.

Most practitioners start with a 15-prism diopter Fresnel press-on prism and increase the prism power (20 to $30\triangle$) depending on the patient's response to prism (Brilliant, 1999). Often, Fresnel press-on prisms are initially used because they are inexpensive and allow for the flexibility to add or subtract prism power to spectacles, cutting back on the prisms as necessary to adjust to a patient's comfort level during training. Fresnel press-on prisms often offer a good beginning point where a person can see if they even like the idea of using prisms or not.

A yoked prism system—a pair of identically powered and same direction full-field prisms—is also prescribed for visual field enhancement. The prism base is always oriented towards the visual field defect, requiring only a 4-diopter prism in each eye. The yoked prism works best for patients with homonymous hemianopsia and visual midline shift syndrome. The yoked prism is beneficial in that it shifts the image to the seeing area and realigns the patient's perceived midline of space to the patient's actual anatomic midline (Brilliant, 1999). In some instances however, the patient may adapt to the prism, making it ineffective.

In general, patients with better acuity, including macular sparing, benefit most from field enhancement. This factor works well for those with hemianopsia as their visual acuity is often very good but there is field loss. Additionally, patients with the poorest travel skills often notice the greatest improvement when using a prism system (Perez & Jose, 2003).

From our experience, it is essential that the low vision optometrist is provided with input from other rehabilitation professionals involved in the patient's care. Vision-related professionals, such as the low vision therapist and orientation and mobility specialist, are particularly responsible for providing input on functional use of the prism adaptations. Through constant communication, the low-vision optometrist may recommend modifications, such as cutting back on the Fresnel prisms, recommending that a different type of prism is tried, or discontinuing training altogether.

Some practitioners will modify the placement of the Fresnel press-on prism as the patient learns to scan more efficiently into the affected side of the visual field. The prism is gradually moved further away from the visual axis (center of the pupil) toward the affected visual field area. Some practitioners feel that the prisms aid the patient's scanning ability to a point where the prisms are no longer needed.

Visual Field Expansion

Another approach to falls prevention is to expand the visual field. Eli Peli from Schepens Eye Research Institute originated the concept of Expansion Prism (EP) lens. Peli (2000) described a novel prismatic device to expand the visual fields of patients with homonymous visual field defects. He prescribed high-power Fresnel press-on prism segments (40△) across the whole width of the spectacle lens above and below, which simultaneously expanded 20 degrees of horizontal visual field in the upper and lower peripheral visual fields. These prism segments are usually prescribed in one lens on the side of the visual field loss. This field expansion device may also be prescribed in the upper segment of the lens only, allowing bifocal utilization. A multicenter community-based research project found significant benefits of the peripheral prism glasses for obstacle avoidance in a variety of mobility situations (Bowers, Keeney, & Peli, 2008).

The visual field expansion concept was further developed by Chadwick Optical, Inc. In this design, the permanent rigid form of the Fresnel prism segment is embedded in a plastic spectacle lens (Bowers et al., 2008). A starter kit for fitting the EP lens may be purchased. This kit includes precut temporary Fresnel press-on prisms (40△) in a set of two, or four sets of two (8 × 22 mm). An EP-Horizontal Screening Device is also available. It is critical to select an adequate frame size to meet the fitting criteria. An optimal separation between upper and lower prisms is 12 mm and the carrier lens must have clearance of 3 mm or greater to the edge of the lens. A permanent EP lens may also be ordered once a patient is successful with the temporary EP lens.

Vision Rehabilitation Training Techniques

Developing efficient scanning technique is one of the key areas of training. Frequently, those with hemianopsia exhibit deficits in search saccades, fixation, and scan paths (a series of saccades and fixations used when viewing a structured scene). The person is also more likely to dwell on the intact hemi field and their saccades are less regular, less accurate and too small to allow rapid, organized scanning or reading. Because of this, relevant parts of the environment are missed. Therapy to assist with these difficulties includes training of saccadic movements, fixation, and organized scanning methods.

Most frequently, rehabilitation incorporates improving the awareness of the visual field loss and using visual search strategies to encourage the individual to scan into the impaired side. Search strategies include increasing head movements and fast eye scanning movements to the impaired side (Rowe, 2008).

Therapeutic intervention as outlined by Scheiman, Scheiman, and Whittaker (2007) includes a three-step sequence. Initially, the patient is engaged in various search tasks. One technique described forces fixation to the side of inattention by smearing Vaseline or taping one half of each lens on the intact side with translucent tape. This forces the patient to look past the midline in the direction of the visual field loss. Another method for field attention developed by Dr. Sarah Appel involves placing a colored filter on one half of each lens or cutting the lenses of inexpensive sunglasses. When the patient looks in the direction of the field loss he or she will see the color change.

Step two involves having the patient scan a room to find unexpected objects. For example, the person may be asked to find hazards in an area or pick up objects from the floor. Systematic scanning methods may be taught during these sessions.

Step three establishes the warning function of the peripheral retina. In this step, objects approach from the affected side during activities of divided attention. One such activity described is "squares" (http://www.superkids.com/aweb/tools/logic/dots/), which is a free game found on the web. The goal of this game is to establish the habit of quickly and frequently looking into the area of the affected field. Another activity described is "laser tag." The therapist and the patient each hold a laser pointer. The therapist presents the laser spot on the wall and the patient is expected to tag the spot with his laser pointer. This task is graded from two predictable points, and then increased by moving the light beam to an unpredictable position, or a more cluttered area.

According to information from *Functional Evaluation & Training Techniques in the Use of Fresnel Prisms for Individuals with Restricted Visual Fields* by Audrey Smith and Duane Geruschat (2009), training begins in static indoor environments. Instruction later occurs in more dynamic and complex situations, eventually moving to busy outdoor environments, depending on the patient's situation and goals.

When beginning training, patients often are not aware of the hemianopsia (anosognosia) or even completely deny their hemi-neglect (Huber, 2000). If a person does not realize that they have a portion of their visual field missing, safe travel will most definitely be impaired. Once prisms are trialed, it is not uncommon for patients to comment on how the prisms have helped them to realize how much vision they were previously missing from their field loss. Even without the use of prisms, scanning can be improved. However, prisms often provide a much-needed enhancement when training someone to improve scanning and to have a better awareness of their missing visual field.

For some people, training on the use of a long cane can be helpful in both detecting objects and people in their missing field. In addition, long canes communicate to others that the cane user has a vision impairment. It should be noted that the orientation and mobility specialist needs to check the cane laws in the state that the patient lives in, and the patient should be educated that some states, such as Oregon and California, do not allow one to use a long cane unless the cane user is legally blind. For people with hemianopsia, the purpose of a long cane is simply to detect hazards in the part of the person's missing visual field. Therefore, in the majority of the cases a diagonal technique is preferable. Some people even prefer to keep the cane tip off of the ground if they are not worried about drop-offs and changes in elevation. It is very common that people find the cane to be the most useful during orientation and mobility training. Then, after they improve their scanning techniques and become more comfortable with travel, they may prefer to stop using the cane or use it on a less frequent basis. Of course, this varies from person to person.

Rowe (2008) describes visual restorative therapy as a technique that includes flicker stimulation of the blind field, which produces changes in the cortical function with supposed cortical reorganization. She points out that improvement has been noted in locating moving flickering objects in the blind field, and improving navigation skills, reading ability, and visual sensitivity. Even so, this technique is controversial in that although some expansion of the visual field loss has been reported, none of the treatment options have shown permanent amelioration of the visual field loss.

As with any therapeutic intervention, it is essential that the patient is educated about his or her deficit and provided with a layman's explanation of compensatory strategies. Even so, simply understanding the problem is not enough. The person must practice compensatory scanning and make it an ingrained habit during their everyday activities (Hellerstein, 2002). Management should include optical and nonoptical devices with focus on the functional activity the person wishes to perform.

Effects of Visual Function on Other Rehabilitation Therapies

According to Hellerstein (2002), vision that is the primary sense for obtaining information from the environment is overlooked in rehabilitation after a stroke. Initially, life-saving measures are provided during the initial stage of the disease. Once the patient is medically stable, the functional aspects of vision are frequently overlooked. Several thousands of dollars may be spent on rehabilitation without addressing the visual implications of stroke. Ways the vision rehabilitation professionals and other rehabilitation professionals (e.g., occupational therapists, physical therapists, speech and language therapists, kinesiotherapists) may work together include:

- Providing patients with training on how to scan or locate objects in the affected field while learning to feed themselves.
- Making sure the patient is prescribed appropriate glasses to "see" the task before being taught to read or use the computer.
- Consulting with one another in regard to reteaching walking while the patient is patched for diplopia, as patching may have a negative effect on balance.
- Consulting with the low vision optometrist in regard to the patients who have vestibular dysfunctions causing dizziness, vertigo, or balance problems. Wearing invisible or no-line bifocals may aggravate the dizziness and cause a decrease in balance.

In addition, many who have been diagnosed with "mild" brain injuries often exhibit subtle vision-related issues, such as sustaining near tasks, poor depth perception, loss of place and skipping lines when reading, and headaches. By consulting with vision rehabilitation professionals, difficulties may be identified and ameliorated early on in the rehabilitation (Hellerstein, 2002).

Therapeutic Cost

In general, we have found that optimal training with prisms ranging from 5 to 15 sessions. Additional visual rehabilitation services are dependent on the difficulty the patient has, as well as their personal goals. Fresnel prisms cost around $20 each, whereas ground-in prisms range from approximately $600 to $1,000.

Conclusion

Because there have been wide variances of the results from visual search training, prism therapy, or visual restorative therapy, when working with the patient with hemianopsia, the decision on which treatment option to pursue must be made according to the individual's needs and requirements. In order to treat the person as a whole instead of parts of a whole, it is crucial that vision-related services and other rehabilitation services work together to provide a comprehensive, multidisciplinary approach toward each patient in preventing falls.

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