Physical Therapy and Monocular Vision Loss

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ABSTRACT

Loss of vision in one eye (monocular vision) may potentially lead to physical deficits. Vision loss with physical deficits affects activities of daily living, balance, ambulation and functional mobility that are required and necessary for one's quality of life. Physical therapy assists these individuals in regaining control and independence that now pose a challenge. The author describes how a physical therapy rehabilitation program gives guidance to a person on how to improve deficits that may arise with loss of vision in one eye, using exercises targeting depth perception, coordination, proprioception, balance/gait training and overall functional mobility tasks.

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Introduction

Loss of vision is challenging for the patient both emotionally and physically. Activities of daily living, balance, ambulation and functional mobility are affected, not just one's vision. Our balance is controlled by three systems: vestibular, somatosensory and vision. With the loss of or dysfunction of one system, the body must adapt by using the other two systems to maintain balance.

The loss of vision in one eye (monocular vision) may result in decreased proprioception (knowing where you are in space), depth perception, and eye-hand coordination, thus affecting activities of daily living, functional mobility and gait/balance. Familiar routines including holding a glass, reaching for a dish, stepping off a curb or over a rug and transferring onto a chair at a restaurant pose new challenges.

Visual loss may be detrimental to a person's well-being, impacting and disrupting their lifestyle. Daily activities that are the epitome of our independence such as going to a restaurant, driving, community and household ambulation, shopping, eating/drinking, reading, and household chores prove difficult for these individuals . Tasks that are second nature to most and completed multiple times throughout the day may become equivalent to running a marathon to these persons. It has been noted that when a person closes their eyes, postural swaying increases by 20–70%.[1] With the loss of vision in one eye, postural sway in static standing intensifies for these individuals, increasing the risk of falling . It has been shown that 26–48% of visually impaired individuals spend less time in moderate physical activity than sighted persons.[2] One reason may be a fear of falling, therefore these individuals spend more time in bed/chair to prevent falls from occurring.[2] It is encouraged for these individuals to take part in physical activity and

receive additional help from a physical therapist if needed. Physical therapy can help those with monocular vision loss to improve their quality of life and maintain their independence by using compensatory strategies to address their balance and overall functional mobility. This article aims to provide insight on how skilled physical therapy interventions assist these patients in their every-day life and give some helpful tools for their support system and ocularists in ways they can assist these patients with their independence.

Author's Note

As a certified stroke rehabilitation specialist, the author's experience originates from working with the stroke population in the acute care, inpatient rehab, and outpatient settings. The tools learned in each setting aided in the creation of individualized rehabilitation programs for patients with diagnoses involving monocular vision loss.
A thorough evaluation is needed for each patient to identify specific impairments and to initiate a plan of care designed tailored to the patient's needs.

There is limited research on monocular vision and physical therapy intervention. The information below is obtained by discerning the patient's specific deficits and treating those with the physical therapist's experience, clinical reasoning, and knowledge. The exercises featured below are some of the few incorporated by the author into the monocular vision loss physical therapy interventional plan of care.

Neuroplasticity

Neuroplasticity is the brain's ability to adapt and modify the body's nervous system through function and repetition. The process involves neurons in the nervous system reconnecting and creating new synapses, allowing the neurons to communicate with one another again. The ability of neurons to communicate with one another allows for muscle memory and learning new functional skills. Neuroplasticity never ends. When we are young, the brain can connect and communicate at a faster rate than an older adult's can; however, it is still possible to develop new connections.[3] This is important for a newly monocular patient in learning skills to accommodate and compensate for the new deficits acquired. The keys to boosting neuroplasticity are the repetition of a task (more importantly, functional tasks) and appropriate feedback from a physical therapist.

Depth Perception

Depth perception is the ability to judge the distance of items in one's space. Many diagnoses may cause a loss of depth perception, including the partial removal of one's visual field. Depth perception is achieved by both eyes coordinating together to judge distances. The body can adapt to the loss of one eye and generate better spatial awareness. Eye exercises such as those in Figures 1-5 help achieve brain and eye communication and strengthen fatigued eye muscles.

Figure 1. Smooth Pursuits—Follow a moving target with your eyes without moving head. Make it harder by having a busy background, reading a small card, standing up, walking, etc.

Figure 2. Saccades—move eyes quickly from one target to another. Make it harder by having a busy background, standing further away, different colors, smaller targets, using words instead of one letter, etc.

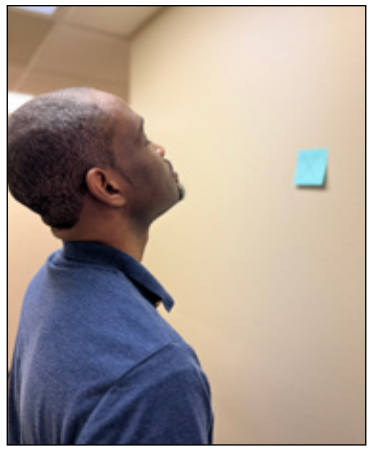

Figure 3. VOR 1—Keep your eyes on the letter in front of you while moving your head up and down.

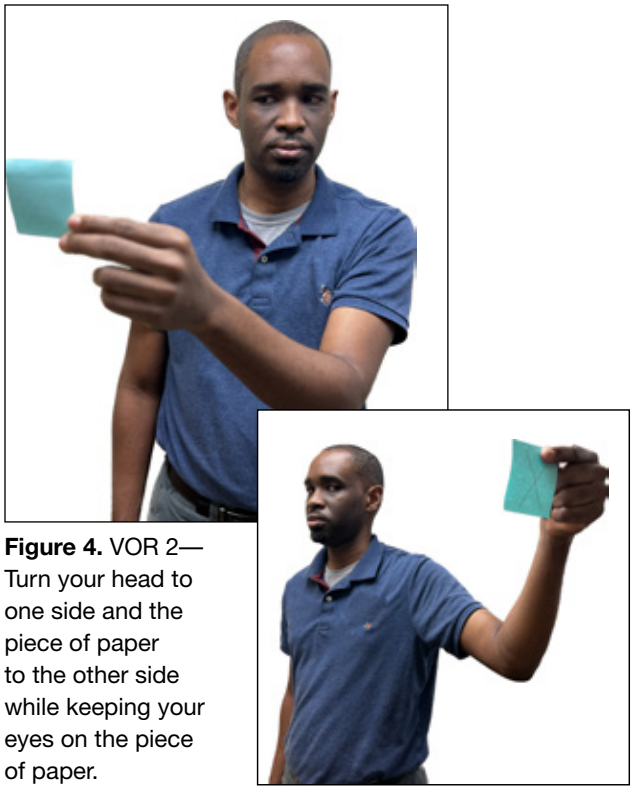

Figure 4. VOR 2—Turn your head to one side and the piece of paper to the other side while keeping your eyes on the piece of paper.

Figure 5. Convergence Pencil Push Up "Holding a pencil/pen or similar target, slowly move object from arms length toward your nose. Focus on the tip of the pen displayed on target. Continue to move the target toward nose until double vision occurs. At this point, move the target back slightly until double vision resolves. Hold the target in place for a few seconds and repeat exercise. Work on improving this threshold by achieving a closer distance from your nose each time (as able). Make this harder by doing it in standing with feet together, split stance (standing with one foot in front of other) or on 1 foot.[5]

Eye-Hand Coordination

Eye-hand coordination is the combination of proprioception and processing visual input. Utilizing exercises with vision and hand movements can help improve eye-hand coordination. Following are a few examples (Figures 6–8).

Figure 6. Reaching cones or targets at varying distances. Make it harder by standing further back, making objects smaller, add more than one object, color code, etc.

Figure 7. Ball toss

Figure 8. Cup to mouth

Proprioception

Proprioception is joint position sense. We sense our body position in space through receptors in muscles, joints, ligaments, skin and tendons. An intact sense of joint position is crucial, especially without visual feedback, because it allows us to interact with our environment, plan our movements and develop new skills. Tasks that improve a proprioceptive deficit include dual-task training, somatosensory (touch perception) provocation, balance exercises, motor control exercises and joint positioning training.

Dual tasking is combining two or more tasks and performing them simultaneously (Figure 9). Most daily activities involve dual tasking, whether a person is walking while talking to someone, driving while listening to music, shopping while looking for a certain item, or drinking out of a cup while standing up. It has been shown that the inability to carry out two or more tasks at the same time correlates with a higher fall risk.[6]

Figure 9. Walk carrying water cup

Figure 10. Stand on Airex with eyes closed. Standing on a foam mat incites the somatosensory system making it more difficult to feel the surface at the bottom of your feet. Closing one's eyes while standing on a foam mat isolates the somatosensory system even more by taking out thevisual system to help keep balance.

Balance

The integration of the visual, somatosensory and vestibular systems control balance. Monocular vision loss may affect balance as a dysfunction of the visual system forces one to rely on or compensate more with the vestibular and somatosensory systems. In order to strengthen the somatosensory and vestibular systems for better control of balance and restore sensory input, they, as well as the visual system, need to be challenged in isolation (Figures 11–13). Incorporating treatment strategies with regard to the Clinical Test of Sensory Interaction Balance (CTSIB) assessment can be helpful in doing so. In this assessment, the patient undergoes balance tests in six conditions:[7]

1. Stand on firm surface, eyes open
2. Stand on firm surface, eyes closed
3. Stand on firm surface, visual conflict dome
4. Stand on foam surface, eyes open
5. Stand on foam surface, eyes closed
6. Stand on foam surface, visual conflict dome.[7]

Figure 11. Balance. Side stepping over cones. Side stepping and over objects does not just improve balance and proprioception, it also helps to improve coordination, lower extremity strength and endurance.

Based on the performance of these six tests, the conditions or dysfunctions identified are as follows:

- Patient who is dependent on vision becomes unstable in condition 2, 3, 5 and 6
- Patient who is dependent on somatosensory inputs become unstable in conditions 4, 5, 6
- Patient with vestibular loss become unstable in conditions 5 and 6
- Patients with sensory selection problems become unstable in conditions 3–6.[7]

The conditions tested can become treatment tasks by having a patient stand or walk on various surfaces with eyes closed versus open, head turns (Figure 14), cognitive and dual tasking, and reaching out of the base of support; all dependent on the specific deficits found in the initial evaluation.

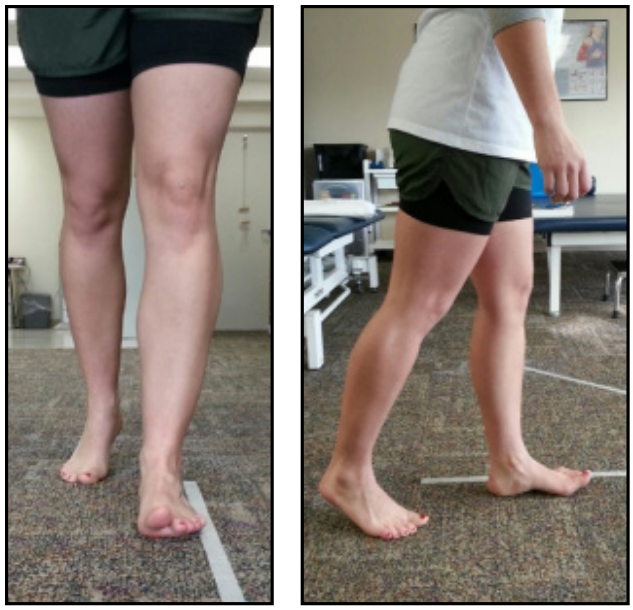

Figure 12. Motor Control with Tandem Weight Shift. Begin in a stagger stance and lift toe of front leg. Shift weight forward by lining knee with second toe of front foot without losing trunk, hip, knee and ankle/foot control.

Mobility Training

Mobility training involves integrating muscular strength and length with functional training to improve a person's ability to navigate their environment safely. It helps the patient compensate for the loss of visual field by using their other senses and balance systems to move around. Visual scanning is an important way to negotiate environment.[8] There are various ways to improve the compensatory strategy of scanning the environment (Figure 15, next page) and mobility training with the expertise of a physical therapist:

- Move head while ambulating to scan the environment for walls and objects
- Navigate an obstacle course with different objects and surfaces
- Forward and backward walk with head turns
- Place stickies on wall with colors/letters/words and identify each while walking
- Laser pointer attached to headband to aim at targets
- Gait/curb/stair training with appropriate assistive devices
- Balloon toss
- Cancellation tasks.

Figure 13. Joint positioning.

Figure 14. Standing on foam while turning head side to side. Vestibular and somatosensory systems are being challenged; therefore, one has to rely on their visual input to maintain balance.

Figure 15. Play I Spy. Make it harder by incorporating balance exercises while trying to find the objects on the sheet.

Patient and Family Education

Monocular vision loss and its accompanying challenges can also affect the patient's support system. It is important for a physical therapist to educate both the patient and the patient's family. The patient may have to rely on family members to complete daily activities safely. The patient might not be able to drive any longer, drink from a glass without difficulty, assist in household chores, go grocery shopping, or walk in their home or community without fear of falling or running into objects. These challenges increase the burden on the patient's support system. It is important for family members to allow the individual to complete tasks as independently and with as good safety awareness as they are able. There are different tools that the family and patient can use to help them achieve daily activities more autonomously and safely, such as:

- Using plastic dishes and cups instead of glass in case of dropping and shattering
- Lining steps at home with brightly colored duct tape
- Removing rugs and unnecessary small furniture inside the home
- Placing night lights around the house if the patient gets up at night time
- Talking to the patient on the non-seeing side so that the patient must turn their head
- Placing objects on the patient's non-seeing side while they are in bed or sitting in a chair.

It may be beneficial to have a family training session with the physical therapist if the patient needs more assistance. The physical therapist can demonstrate and teach family members proper hand placement to assist transfers, showcase what the patient is capable of completing on their own, use of safety equipment and proper exercise techniques.

Many of the aforementioned practices are also useful in the ocularist's office. Accommodating patients with these tips and tools during their appointment will be helpful for them to navigate around the environment safely with more ease. Removing rugs in the office, placing objects in the rooms such as tissues into their visual field, and guiding patients to their chairs in a simple location are all simple actions that can make a profound impact on the patient's life. Simple transfer training of ocularist office staff from a trained physical therapist promotes overall exceptional patient care and improves clients' quality of life.

Conclusion

Tasks and exercises should be relevant, specific and personalized to a patient's plan of care. The above examples are all tasks that have been helpful in addressing patient goals, deficits and overall wellbeing. It is not to say that these examples alone are enough to assist patients in their newly acquired visual impairments. The ocularist will be able to use some of these tools to help their patients manage monocular vision. The expertise of a physical therapist can aid the patient further in identifying specific deficits, developing a plan of care catered to the individual, and finding ways to both educate and treat the impairments in question.

ABOUT HEATHER ALBERICO

Heather Alberico is a Doctor of Physical Therapy who attended the University of St. Augustine. She was introduced to physical therapy as a young gymnast and later while interning under the Gator Gymnastics team at the University of Florida. During graduate school, she acquired the neurological condition CRPS and spent months as a patient at a PT clinic. It is through her own personal experience that drives her to want to help patients regain some independence and mobility after a life changing event. Heather obtained her stroke certification and has worked with patients' acute stroke in the ICU to chronic stroke in the outpatient setting. Heather currently lives in Ocala, Florida and enjoys spending time with her husband, Jeremiah, and son, Kingsley.

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