A Rationale for the Use of Prisms in the Vision Therapy Room

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Abstract

Vision therapy involves the use of lenses, prisms, filters and instrumentation to effect change in the neurological pathways that direct our visual system. Prisms of moderate to high power can have powerful effects on this neurology and should be considered primary tools in the therapy room. Prisms and lenses have optical, perceptual, and visual properties that make them unique in the effects they are able to create. This makes them a valuable tool in the vision therapy room. This paper will explore the rationale behind prism-based therapy procedures and uses procedure examples to help the reader integrate prisms into their therapy routine.

Key Words

lenses, magnocellular, parvocellular, periphery, prism, vision therapy

Prisms as Therapy Tools

Prism is the ideal therapy tool. The goal of vision therapy is to engage the attention of the patient, provide feedback, and stimulate brain-based changes. The prism can do all of these.[1] Getzell has espoused how prism in the therapy room can be used to create total "eye-mind-body" changes and improved perception of depth and space.[2] Prism produces changes in orientation with corresponding shifts in both eye movement and pelvic positions.[3,4] They are a valuable tool in breaking down patterns that have developed over time that enable the patient to cope with their visual condition. This is especially true of higher powered prism (5^{Δ} to 15^{Δ}).

Optically, the prism bends light rays towards the base causing an apparent shift of the image towards the apex from the viewpoint of the observer. This provides a mismatch between the information received via the visual pathways and the information from the vestibular and proprioceptive pathways.[5] Prism causes an object to appear at a different location in respect to its actual placement. The patient must attend to these sensory inputs simultaneously and make adjustments to perform the therapy tasks.

For many patients, simply the novelty of the shifted image is enough to engage them in the tasks. For others, guidance from the optometrist and/or therapist is necessary to bring the changes induced to a conscious level. In both cases, the prism provides an ideal neurological stimulant to change the visual processing pathways of the brain. One of the more obvious advantages of using prism in the therapy room is the ability to perform activities in free space. Though there are many new "high-tech" instruments available, some restrict movement, periphery, or both. The use of prism glasses allows therapy to be performed while the patient is on their feet and moving. Bringing movement into play allows the patient to receive tactile, proprioceptive, and vestibular information. This adds a tremendous amount of information in addition to the visual stimuli. It results in a greater number of problems to solve and the need for the patient to develop flexibility and be cognitively involved in the learning situation created by the clinician. Since we live in an open, three-dimensional space world, this mode of therapy has tremendous carry-over to the real world. Conversely, the use of prism glasses allows the optometrist to observe the movements of the patient's eyes during the procedures.

Besides the directional optical shift, prism provides many other changes unavailable in other optical and non-optical therapy instruments. The base of the prism has a net plus lens effect, with images being shifted further out in space from the observer. The apex of the prism does the opposite. It has a net minus power effect, with images being moved closer to the observer. As a result, there is a z-axis *slant* that is induced, resulting in even more visual-perceptual mismatches than a simple directional x-y axis shift. In addition, straight lines are curved in the direction of the prism's base.[6,7]

These spatial warps provide even more stimulation of the neurology of the visual system. This requires greater attention from the patient and for them to attend to the total volume of space while performing the visual-motor tasks at hand.[1] The subtle spatial shifts provide an opportunity to teach the patient to appreciate just noticeable differences (JNDs) in size, position, and orientation. The use of the prism in a free space setting allows asking open-ended questions to trigger greater and greater exploration of the visual environment. It has been said that the ideal vision therapy procedure stimulates convergence, accommodation, eye movements, and peripheral awareness. Properly used, these prism-based therapy procedures can elicit changes in all of these visual skills areas.

Engaging the Periphery

Recently, much of the research on the human visual system has been directed at increasing our knowledge of the *magno*

and *parvo* cellular systems. The magnocellular system is designed to process information largely in the periphery. The parvocellular system is the more central visual system.[8,9] From the very beginning, behavioral optometrists have been aware of the importance of the peripheral operating visual system.[3,4] In addition, most are also aware of the importance of improving peripheral visual processing in the vision therapy room. Over the years, projectors have been used to create large targets that have a greater effect on the peripheral vision system.

However, many of these techniques create peripheral two dimensional targets. They can also limit movement of the therapy patient. Prism-based therapy procedures do not have these limitations. Their ability to engage the magnocellular system should make them attractive. The strength of prism-based procedures is that the slant optical effect, combined with the ability of the patient to move through space, provides optical changes in all three dimensions. Awareness of visual, vestibular, and proprioceptive changes and mismatches often results in rapid progress in a vision therapy program. The patient will master activities once they begin to tune into the peripheral visual spatial changes induced by the prism. Beyond improved visual skills, such as accommodation and convergence, the optometrist will also see positive changes in balance, posture, coordination, and thinking.

Prism Therapy Procedures

The following are three in-office procedures that are among the universal procedures that almost all of our patients experience. I hope that you will try them in your office and look for other ways to integrate the use of lenses and prism into your vision therapy programs.

Materials Needed

The prisms referred to here are incorporated into six pairs of glasses. Two pairs are vertical dissociating prism: one with 5^{Δ} base up in the right eye, and 5^{Δ} base down in the left eye, the second dissociating prism glasses have the prism base down in the right and base up in the left. The other four pairs of glasses are yoked prism oriented as base up, down, left, and right. Though I prefer using 10^{Δ}, it is equally acceptable to use 8^{Δ}, 12^{Δ}, or 15^{Δ}. For variety, I also alternately use plano and curved prism. There are differences in the optical characteristics with the curved lenses having induced cylinder that is not present in the flat front lenses.[4] The following are three of the many prism activities that take place in our therapy sessions. These are not performed only once in the therapy sequence as we return to them many times over. As the patient becomes more aware of their visual space world, they will be able to verbalize to a greater extent the change induced by the prism.

Prism Eye Rotations

Materials:

Two pairs of vertical dissociating prism glasses

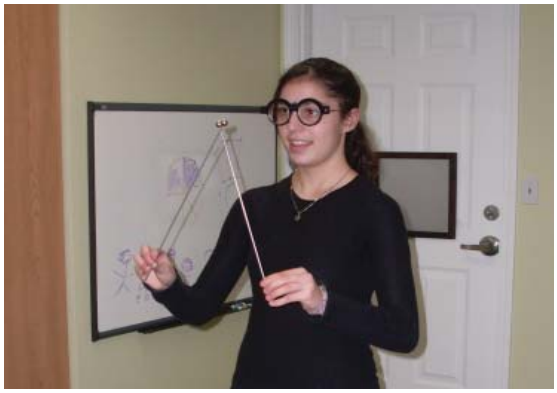
2 Wolff wands

Procedure:

The patient is to be on their feet, standing with feet shoulder width apart. Wearing the first pair of prism glasses, the first Wolff wand is given to the patient. They are instructed to hold the wand with the ball at eye level about 15 inches from their face (Figure 1).

Figure 1: Prism Eye Rotations- The patient holds the wand with the ball at eye level about 15 inches from their face.

Figure 2: Prism Eye Rotations- introducing a second wand will make this procedure more difficult



The procedure should begin by asking open-ended questions such as "What do you see or notice?" For some patients this is enough to elicit a long list of responses regarding what they see. For others, guidance may be needed. To elicit appropriate and useful responses, questions about how many targets they see, differences between the two images in size, position, color, and height are posed. Some patients require a single question to get going, others require more "teeth pulling."

The patient then slowly, using his hand and wrist, moves the ball in a circular, horizontal path, at eye level. They are asked to follow the ball as it is moved and report any changes they see. They are reminded to continue to blink and breathe. The therapist is to observe any tension, breath holding, or white knuckles. The direction of movement is reversed every 3 to 4 revolutions. After 3 to 4 minutes the glasses are switched to the 2nd pair of dissociating glasses.

Once the patient has mastered the basics of the movements and is comfortable with the motion, the demand is increased by asking them to be aware of the periphery while they continue to follow the ball as it moves. They will be able to process more and more of the total volume of visual space.

Prism activities such as this have a large number of variables that can be altered to change the demand and difficulty level. Suggested variations include adding binasal occlusion and introducing a second wand (Figure 2). When using a sec-

ond wand, the hands are kept shoulder width apart with each one holding a wand. The two ball ends of the wands criss-cross at the tips and the balls are kept in contact while the patient is asked to repeat the same movements they did with the singular wand.

We like to use this activity at the start of each vision therapy session. This is especially true for our patients that have strabismus or amblyopia as it is a powerful anti-suppression procedure that also works on accommodation, convergence, eye movements, and peripheral awareness. It is also very useful in teaching our patients to appreciate the concept of SILO (small in, large out). In addition, asking the patient to use a finger to touch the ball helps them to better develop matches between the visual and motor systems.

Prism Walking Activity

Materials:

Four pairs of yoked prisms (suggested power = 10$^{\Delta}$)
Base up, down, left, right

Walking rail:1" x 6" wood plank works very well

Eye level target beyond the walking rail

Procedure:

With the patient on their feet, they are shown the walking rail and asked to stand on it in a relaxed posture. They are asked to fixate on an eye level target and walk heel-to-toe forward until they reach the end of the ball. They then maintain fixation while walking backwards in the same fashion.

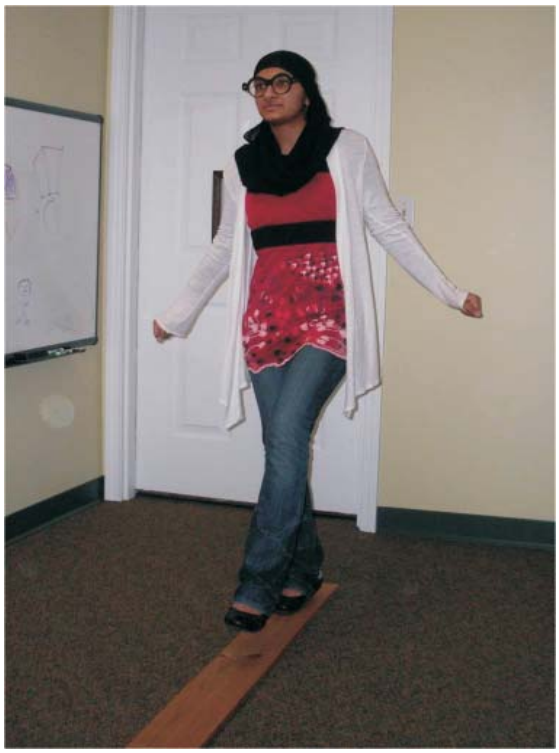
Base down prism is usually tolerated the best, so it is introduced first (Figure 3). Before they walk on the rail they are asked what changes, if any, they notice. As in the previous activity, some patients offer a tremendous amount of detail while others offer very little. Don't rush the patient as it may take time for them to deal with the changes caused by the prism. Ask open ended questions to help them notice changes in size, position, slant, etc. It can take several weeks of vision therapy for a patient to become a good reporter of changes in their visual space.

After several minutes of walking forward and backward on the rail, the glasses are removed and the next pair (base up) is placed on the patient. The activity is again repeated with base right and base left yoked prism. Some patients need a minute or two between prism glasses to relax and become grounded again. As the patient becomes more comfortable with the activity and movement, they are asked to become more aware of their periphery.

The difficulty level can be increased in a number of ways. When taking a step, raise the leg high enough so that the thigh is parallel to the ground and hold it there for a moment before putting it down in front of the other foot. This is repeated both forwards and backwards.

The most advanced level of this activity involves bending from the waist between steps (Figure 4). Before a step is taken, the patient bends 90 degrees at the waist and watches their feet as the back foot moves in front of the other foot and placed down. They then stand up and regain fixation at the eye level target. This is a very difficult movement as it takes time to learn only to move the feet while in the bent posi-

Figure 3: Prism Walking Activity- The patient wears prism and is asked to fixate on an eye level target and walk, heel-to-toe forward and backwards.



tion. Balance is often lost while moving from the bent to the upright position. Care should be taken, especially in older patients, to make sure that the patient does not fall over. Positional changes add additional vestibular and accommodative components to the activity. Variations include the introduction of binasal occlusion, and using targets above and below eye level.

While new patients may only give limited observations of the prism-induced changes, as they repeat these activities during future sessions, they will notice more as their ability to process visual information improves. The more experienced therapy patient can spend a great deal of time within a therapy session exploring and discussing the changes they encounter.

Bean Bag Tossing with Prism

Prism can be added into activities that you might already be performing, especially if they involve movement. One such activity is bean bag tossing.

Materials:

Baskets of various sizes

Bean bags – 8 to 12

Strong yoked prism glasses, base up, down, left, and right

Instructions:

Starting with one of our larger baskets, the patient is asked to gently toss in the bean bags into the basket. They are asked to use underhand tosses and attempt high-arching trajectories. When fairly successful, base down prism is introduced (Figure 5). The bean bags typically overshoot the basket, often by several feet. The patient is asked to tell what happened

Figure 4: Prism Walking Activity- The most advanced level of this activity involves bending from the waist between steps.

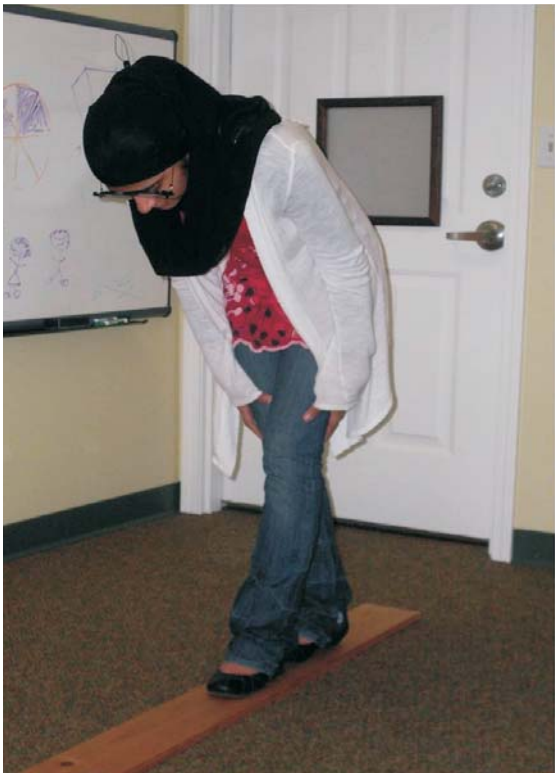


Figure 5: Bean Bag Tossing with Prisms- The patient is asked gently to toss bean bags underhand and with high-arching trajectories.

and to see if they can correct for the induced changes. We also demand that they pay close attention to where their tosses end up. They usually catch on quickly and regain success in the tossing. The activity is then repeated with prism in other directions.

As in the other procedures, much can be done to make the activity more difficult. Suggestions include: occluding one eye, using binasal occluders, and asking them to aim their eyes at a target away from the basket and using their peripheral vision for aiming. In addition, as proficiency improves, smaller baskets can be substituted to increase the difficulty. Always remember to take care not to make things too hard, too quickly, as a fun activity can rapidly become frustrating. We have found that a 70% success rate will keep patients well engaged.

Summary

The use of prism in the vision therapy room provides a dynamic, free space mode of therapy very different from that provided by computers and other instrumentation. The exploration of changes induced by prism provides an avenue for a total mind-eye-body form of vision therapy. Our patients have found these activities to be both challenging and enjoyable and look forward to the experiences that they provide. We have found that we can return to these procedures again and again.

Prism is a powerful tool. The various optical distortions it provides allow for neural changes that affect the patient's sensory-motor and vestibular-anti-gravity systems. It is the author's hope that the reader will try these and other prism procedures on their patients and perhaps, even on themselves. You will gain much insight into not just *what* your patients see and perceive, but *how* they see, perceive, and process visual information.

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