USE OF ROTARY PRISMS AS A MODALITY DURING PHYSICAL HANDLING

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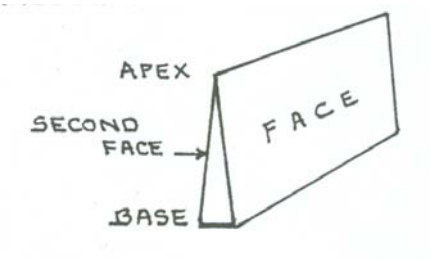
Learning Outcomes

The Participant Will be able to:

1. Describe the general influences of prisms.
2. Describe how prism lenses influence movement and posture.

General introduction to prisms and their influences

Prism lenses are prescribed by optometrists to affect the way that space is perceived, and to affect how the body reacts to that change in perception. Prisms are 3-sided transparent pyramids that have a base and an apex.



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Prism Configuration

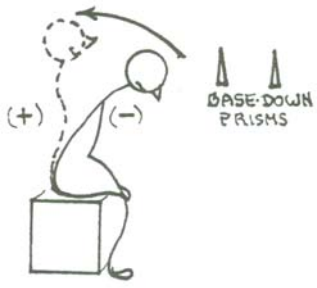
The orientation of the prisms over the eyes affects how space is perceived. Prisms can be positioned in a variety of ways. They can be “yoked” meaning both prisms are oriented with the base in the same direction. In other words base left refers to prisms whose base is oriented to the persons left side. The left eye prism base orients laterally while the right eye prism base orients temporally, thus both prism bases orient toward the persons left side. Prisms can be yoked in a variety of ways such as base left, base right, base up, or base down.

In general the base of the prism is oriented to counteract the persons tendency to tilt to one side or to tilt forward or back due to a CVA, TBI, or developmental disability.

Base left prisms for example shift the perception of space (that is the horizontal) to the right. This shifts the head-neck and body alignment toward the right side, effectively changing the midline orientation of the body.

However the optometrist may prescribe the base opposite the direction of the person's tilt thus attempting to compress space on the unaffected side and increase the proprioceptive feedback to illicit a righting reaction back toward midline. The particular alignment of the prisms will depend on the optometrist's evaluation of the person's visual system and visual-postural function.

Prisms refract or bend light thus changing the line of sight of the eyes and can result in the eyes moving into a more correct alignment to enable binocular vision. They can change postural tone by influencing head/neck and body alignment in relation to the vertical and horizontal planes of space. Yoked prisms are used to influence postural tone, postural reactions, and balance. By changing the perception of midline they facilitate the person shifting their weight, thus increasing proprioceptive input from the base of support through the entire body side. The head/neck and body realign and reinforced the visual, vestibular, and somatic reorganization of midline.



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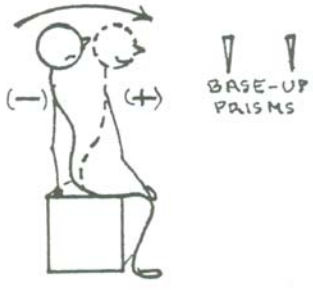
Base Down Prisms

Base down prisms have the affect of moving the perceived horizon up thereby facilitating and extension response.



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Base Up Prisms

Base up prisms have the affect of moving the perceived horizon down thereby facilitating a flexion response.

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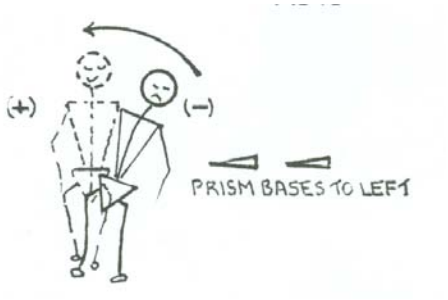
Base Right Prisms



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Base Left Prisms

Base right prisms have the affect of Moving the perceived horizon to the left thus facilitating a shift to the left.	Base left prisms have the affect of moving the perceived horizon to the right thus facilitating a shift to the right

Prisms can also change the perception of size and shape of objects and the perception of surrounding space. Base up prisms make objects appear shorter, smaller and nearer, and are described as compressing space (the horizon becomes slightly bowed downward and towards the viewer thus bringing space at the periphery in towards the viewer). Base down prisms make objects appear taller, narrower and farther away and are described as expanding space (the horizon becomes slightly bowed upward and out and away from the viewer, hence expanding the perception of peripheral space). (1)

Prisms are very powerful orthoptic tools that when used under the supervision of a neuro-optometrist can be very effective in reorganizing the persons, sensorimotor experiences.

Rotary prisms are arranged in a yoked relationship so that both eyes are exposed to the same orientation of the prism base. They are used as an enhancement of the movement experience during a physical handling therapy session. The effect of the prism is to resolve the identified mismatch between proprioceptive, kinetic and visual processes.

In an interdisciplinary approach designed to serve the client who has suffered brain damage, the optometrist specialized in Neuro-Optometry, the physical, occupational and speech therapists all interact, giving the client the specialized input of their professions. In this process there is a necessary overlap of the specific interventions of the individual professions. Under the direction of the specialized optometrist the therapist who is working to normalize motor function can utilize goggles that hold a pair of prisms of a determined power. The power of the prism used for each individual should be determined by standards set in Neuro-Optometry. The prism goggles are used in the therapy session, rotating the prism bases according to the findings in the initial observation of the client's postural adaptation and following the rational of the known influence of each base orientation over the motor response.

Yoked prisms have their effect directly on the ambient visual process. This is the aspect of vision that gives us perception of spatial relationships, or "where I am in relation to my base of support." As the base of support is constantly changing while we move, ambient vision must be dynamic and responsive to our ever-changing postural needs for maintaining anti-gravity alignments while preparing for movement initiation. As soon as the infant lifts his head off the surface the ambient visual process begins to stimulate turning of the head to further explore the environment. In the upright alignment and when moving through three dimensional space the ambient visual process becomes even more important for perceiving surface irregularities and objects in the lateral visual field.

The ambient process, sometimes referred to as "peripheral", helps us to localize our perceived horizon, and this relates to our perception of our horizontal base of support with our individual vertical midline. This information is integrated by the brain with the proprioceptive and kinesthetic experiences, together with any movement signals from the upper limbs and changes in head position. A reach toward a target in space is monitored by the visual system and confirmed by touch, with the proprioceptive and kinesthetic systems participating in the performance. The visual system leads the intentional act, but also monitors ongoing activity.

When the ambient visual process, because of faulty proprioceptive and kinetic feedback, fails to find complete information for fine-tuning of movement, it adapts to a faulty match. This faulty match occurs between vision, postural control and movement. In therapy for individuals with posture and movement disorders, the body responds to handling through the proprioceptive and vestibular systems, expressing the righting and equilibrium reactions that help to readjust the posture and facilitate movement responses. The part of the experience mediated by vision can be modified by the use of prism goggles. New learning occurs under these conditions and a mismatch that was established because of faulty feedback can be resolved. This in turn releases the central nervous system to learn with more accurate feedback and feed-forward, which makes possible a new level of performance.

General prism influences are described by the effect on the subject's experience:

Base up: Shifts the perception of space downwards and forward,
Gives a "grounding" sensation
Constricts space
Promotes neck lengthening
Emphasizes figure over ground

Base down: Shifts space upward and backwards
Gives a "lifting" sensation
Expands space
Promotes neck extension
Emphasizes ground over figure

Base right: Shifts space over to the left side,
Displaces everything that is seen to the left

Base left: Shifts space over to the right side
Displaces everything that is seen to the right

According to Dr. William Padula, (2) who is the primary researcher in this area of study, use of the yoked prisms to change posture and movement, is effective for persons with the following diagnoses, to obtain the changes indicated:

Diagnosis	Shift of Space	Prism base used
Right hemparesis	to the left	Base right
Left hemiparesis	to the right	Base left

By using the prisms indicated above the therapist elicits a righting reaction toward the previously ignored space. This adapts the individual's perception of space and alters the postural adaptation as well as the movement that is initiated into the perceived space.

The individual may also demonstrate:

	An anterior shift	space is shifted down	use of Base down prism
Or	A posterior shift	space is shifted up	use of Base up prism

It is also possible that the client presents a combination of lateral (right or left) shift with a vertical (posterior or anterior) shift, in which case the prism bases have to be combined. Down might be combined with right or left and up with right or left, giving a diagonal influence to change the perception of space.

In the therapy session the individual is given the guided movement experience using first the base orientation that is determined by the observer and after a short period of 5 to 10 minutes the same movement experience is done with the opposite prism base. When the prism base is changed it is made the same for both lenses. The ultimate goal is to give the individual, through the ambient visual process the opportunity to resolve the created mismatch of the faulty feedback and feed-forward, which contributed to inadequate postural adaptation.

Using rotary prisms as an influence on postural organization (Case Study)

Paula is a 3 year-old girl with a diagnosis of mild to moderate spastic diplegia, who has received therapy with a Neurodevelopmental approach. She gained postural control, with good independent sitting that permitted adequate use of hands to participate actively in her preschool classroom. She was able to move independently in a limited environment, but walking on the street, or moving from one room to another, caused fatigue. The fatigue resulted in the child dragging her left leg, with the knee in flexion, and the left foot never landed completely on the surface.

Physical treatment sessions were successful in that Paula would show good standing alignment, but these positive responses never carried over from one therapy session to the next. It was also impossible for Paula to walk for more than 10-15 yards with her family without asking to be carried by an adult.

Observing Paula during the PT session it became apparent that she showed the characteristics of a Visual Midline Shift Syndrome, as described by Dr. W. Padula (2), which corresponds to a left hemiparesis. This is a posterior and right displacement. It is hypothesized that a congenital brain injury like the one Paula had would cause some interference or distortion in early motor development. During this early motor learning a mismatch was created between proprioception, kinesthetic and visual input. This mismatch at the present time was interfering with the possibility for the visual ambient process to lead the postural adjustment and organize a symmetrical posture that forms the basis for an even use of both sides of the body in moving and in performance of activities in upright standing.

The Visual Midline Shift that was identified in Paula was a posterior/right displacement in relation to her base of support. The treatment sequence was developed taking in account the need to restore the match between the proprioceptive –kinesthetic process and the ambient visual. The activities are sequenced to insure success and include balance challenges with rocking of the apparent visual parameters of the surface and the horizon. This is done by virtually moving space and the child's impression of the base of support with the use of rotary prism goggles while performing activities with the whole body. These activities include standing and looking in different directions, catching a tossed ball and standing on a tilt board with adult assistance gradually reduced.

Figure1

Paula is receiving an explanation of what we are going to be doing in therapy. It is important with a child who understands to let her know that the session is going to be a new experience. Most importantly there is not a good or bad response. The child needs to be assured that this is not a situation where judgments are made.

Figure 2

Figure 2 show Paula's usual standing position before starting the experience of movement with the use of rotary prisms. Any lateral shift of her weight resulted in the flexion of the left leg seen here. On the rare occasions that she would stand on the left leg, the right leg would assume the flexed position.

Figure 3

Paula is wearing goggles with a 6 diopter prism with a base up orientation. Base up orientation was selected because a posterior midline shift was identified through observation of her movement in space. A base up prism also tends to ground the individual. She is instructed to look at herself in the mirror and the immediate response is an automatic change in the position of her feet as she placed both feet flat on the surface.

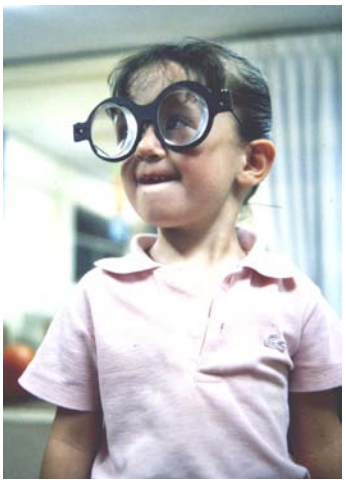

Figure 4

Paula is given time to experience another change in the prism (6 diopter) orientation base left, as she also demonstrated a shift to the right. The base of the prism on the left shifts the child's perceived space to the right, which then elicits a balance reaction with the left side of the body. This will tend to reinforce a protective extension response of the left leg.

Figure 5

Paula has been placed with her back to the mirror and is asked to turn to look at herself in the mirror. This is one way to elicit rotation of the trunk while there is a slight displacement of lateral weight over the foot of the weight-bearing side.

Figure 6

Paula has an opportunity to observe herself again as her image is reflected in the mirror. She is gradually integrating a new body image that is reinforced by the proprioceptive and visual information as she feels her weight supported simultaneously over two feet.

Figure 7

Paula is asked to stand still and the therapist moves her upper body over the lower body in a lateral direction. This permits the child to feel the motion without making a physical effort to control or direct the response.

Figure 8

Once again Paula has an opportunity to observe herself, and she is beginning to make slight weight shifts from left to right and right to left.

Figure 9

Now Paula is asked to change her weight deliberately from one side to the other, while watching the action in the mirror.

Figure 10

Again Paula is asked to move over her base of support to one side and to the other, but now she has a 3/4 view of herself in the mirror.

Figure 11

Observing herself while adjusting her upper body over the lower body makes Paula more conscious of the relationship of one body part to another. She is now able to widen her base of support while keeping her weight on both feet.

Figure 12

An activity with the ball is initiated by handing the ball to Paula so that she takes it directly from the hands of the therapist. This activity will permit Paula to take over automatic control of her standing posture while her hands move forward in space.

Figure 13

Paula is asked to throw the ball, which requires her to maintain stable standing. She began with a very slight pushing away of the ball and gradually increased the movement velocity as she gained confidence in her standing.

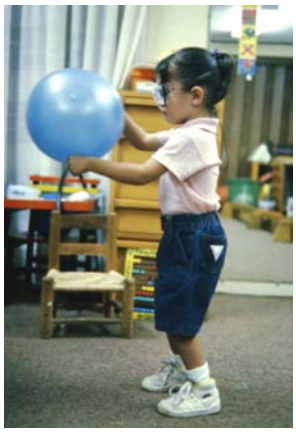

Figure 14

Paula is asked to move the ball vertically while turning it with a pronation-supination movement of her forearms. This gives her a visual experience of changing the ball's orientation in space.

Figure 15

Again Paula takes a break to look at herself in the mirror while she is asked to move up and down in the same posture. This is done with a conscious control of knee flexion done bilaterally and serves as a preparation for the next activity.

Figure 16

Paula is given a beanbag in a position that requires her to reach over her head. She has to extend and control her standing against gravity while keeping contact with both feet on the surface.

Figure 17

Paula is asked to throw the beanbag into a wide stable bucket that is deliberately placed close enough for success.

Figure 18

Paula observes her success in landing the beanbag inside the bucket. She is also activating her postural control to keep her heels in contact with the floor.

Figure 19

When Paula misses the bucket she is asked to pick up the beanbag, which requires her to control her body alignment while moving into gravity. Both feet are now kept in contact with the surface.


Figure 20

When the bean bag activity was finished the therapist again displaces Paula's body in a lateral change of weight. The movement is now a little faster than it was initially, and the child's weight is reinforced with a slight push downward when the body aligns over the foot.


Figure 21

Paula is asked again to extend her arms and her body while keeping her feet in full contact with the supporting surface.

Figure 22

An activity with a balance board is introduced with the prism goggles changed to a base up orientation to give more grounding influence while the therapist provides support in back and in front of the child's body. Paula concentrates on keeping the balance board stable before given a further challenge.

Figure 23

The support given by the therapist influences more extension through the child's arms and the therapist is able to facilitate lateral movement by the amount of pressure and slight push she applies to one hand or the other. It is a normal response to increase leg flexion slightly when we feel insecure in moving. Paula is gradually given the opportunity to restore the stability of the balance board. Finally she is encouraged to initiate movement with one foot to actively change the balance board.

Figure 24

The hands of the therapist are now moved down to the thigh level to remind the child of the need to maintain a good separation of the legs while balancing laterally.

Figure 25

Paula ends the session by looking at herself in the mirror without the prism goggles. It is now easy for her to maintain her improved standing posture with consistent contact with both feet on the floor.

After this one session of experiencing guided movement opportunities with prism lenses that changed Paula's perception of space, she was able to reorganize her postural control.

Figure 26
Beginning of Session

Figure 27
End of Session

The change in Paula carried through after the therapy session. She was able to walk with her family for 3 city blocks without expressing fatigue or asking to be carried.

Summary:

The use of prism lenses under the direction and supervision of a qualified behavioral or neuro-optometrist can effectively modify the movement and postural organization of individuals with physical disabilities and other neurological disorders. Postural reactions that are physically possible (not restricted due to contractures etc.) but not initiated may have a functional vision component. The person may perceive space as distorted or their midline to be more related to their less involved side. Therefore manipulating the perception of space and shifting the perception of the horizon will result in more orientation, weight shift and proprioceptive input from the more involved side with the use of left or right base orientation. In addition they can enhance extension or flexion depending on the need through using prisms with down or up base orientation. A combination of up or down and left or right may also be required. It s essential to refer and be guided by a neuro-optometrist for the correct use of prisms.

References

1. Moore, J.C., Handouts and personal correspondence, 2006
2. Padula, W.V., Neuro-Optometric Rehabilitation 3rd Edition, Optometric Extension Program, 2000

These are the verification exam questions to be answered when you click on Take Exam. For ease of completion select your answers prior to clicking on Take Exam.

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Verification Exam

1. The use of prism lenses to change the perception of midline can facilitate the person to shift their weight, thus increasing proprioceptive input from the base of support through the entire body side.
    a. True
    b. False

2. Base up prisms make objects appear shorter, smaller and nearer, and are described as compressing space.
    a. True
    b. False

3. The effect of the prism is to resolve the identified mismatch between proprioceptive, kinetic and visual processes.
    a. True
    b. False

4. When the ambient visual process, because of faulty proprioceptive and kinetic feedback, fails to find complete information for fine-tuning of movement, it adapts to a faulty match.
    a. True
    b. False

5. A base up prism shifts the perception of space upwards and backward.
    a. True
    b. False

6. The ultimate goal of using prism lenses in a movement experience is to give the individual, through the ambient visual process, the opportunity to resolve the created mismatch of the faulty feedback and feed-forward, which contributed to inadequate postural adaptation.
    a. True
    b. False