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NOTES FROM VISION THERAPY SYMPOSIUM
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Brock speaks of a sensory continuum. Infants develop their visual space world by:

1. picking an object up
2. touching the opbject
3. looking at the object
4. placing the object in their mouth

All this sensory information goes to the reticular activating system of the brain. If the child is diplopic, this prevents the development of a unified sensory continuum because dipolpoia is in conflict with what it experiences tactually, gastrally, etc. The child sees two objects but only feels one. Therefore the child learns to ignore the input from the strabismic eye; it divorces that eye from its physical self.

Kiner says the fetus is in a non-illuminated environment and the position of the eyes is determined by sub-cortical reflexes. An XT develops from abnormal proprioception reflexes of the fixing eye to the non-fixing eye. In support of this idea, if a retro-bulbar injection of anesthesia is placed behind the fixing eye the non-fixing eye will straighten out. The Japanese always do their squint surgery on the fixing eye and they have the highest functional and cosmetic success rate of any country.

Slave-Master reflex for XT's:

If you hold a target in front of the fixing eye (not at the mid-line) making sure only the fixing eye is seeing the target (may use a septum) them move the target slowly laterally, the non fixing eye will straighten and converge. Similarly, if you put an ET in the dark and put a light in front of only the fixing eye, the non-fixing eye will straighten.

Mann and Hien at MIT did the following work. They had subjects point to lighted targets on a blank screen without the benefit of being able to see the rest of their bodies or surroundings. They found that binocular people and alternation strabs could accurately point to the targets using either eye. Unilateral strabs could also point accurately when using the fixing eye; however, when the fixing eye was covered (so the non-fixing eye now picked up fixation and the normally fixing eye was turned behind the occluder) the subject would point in the direction in which the fixing eye was turned behind the occluder. They concluded that the accuracy of pointing depended on:

1. the position of the object
2. the position of the image on the retina
3. the position of the strabismic eye in the orbit

Those unilateral strabs who had the occlusion therapy in the first six months of life, however were able to point accurately with either eye because the strabismic eye had learned to extract information from the environment.

Procedure for overcoming this feature extraction area in unilateral strabismus (procedure is given in terms of ET):

1. Occlude fixing eye. Do tracking(thumb rotations, etc) with strabismic eye but place reverse prism over that eye. (eg. BI prism over an ET. This gives the feeling of abduction and stretches the MR.)
2. Gradually reduce the reverse prism so that even a small amount on BI will give abduction sensation.
3. While tracking with the strabismic eye, randomly place BI, BO, or no prism in front of the eye and have the patient tell you the difference.
4. Now unocclude the fixing eye. Place in neutralizing prism and vertical prism to get vertical diplopia. Make the room as dark as possible and have the patient wear red/green anaglyphs. Instruct the patient to look at a penlight. They should see two targets directly above each other. Now have them look from midline to the right and then midline to the left. They should see the lights moving the same direction and the same speed. Next tag each fovea with an after image. Repeat the above procedure and instruct the patient to keep the after image directly on the targets.
5. Still in a dark room with neutralizing prism, vertical prism, and red/green glasses on the patient, hold two pen lights several feet apart and have the patient do saccades from target to target keeping the targets vertically aligned. Then repeat this with the foveas tagged and instruct the patient to keep the after images aligned with the targets.
6. Repeat steps 4 and 5 on a balance board to stimulate the vestibular system.
   What do you do with alternates? Basically the alternater has four sensory continuums. One for each eye, auditory, and body. At any given moment one eye or the other is connected only to the body. Alternaters do not need to suppress because they are ambiocular. They only run into trouble when you consciously make them aware of two images. The adaped strabismic localizes by looking at a target and whatever is fixed clearly represents the primary projection. The turned eye represents a blurred second image to which he does not attend.

Procedure for breaking down <u>some</u> alternaters (discussed in terms of an ET):

1. Place bi-nasal tapes on the patient's Rx until they see two target. This is done by trial and error.
2. Have the patient wear red/green anaglyphs and fixate on a penlight. Using a prism bar increase BO prism until the two images approach overlap but do not actually do so. Neutralize any vertical disparity with vertical prism and then find the closest special overlap. Put the prism in a Fresnel Rx split between the two eyes. Tell the patient not to let the eye flick, let things blur out in order to fixate them.

Now do the following training procedure:

1. Have the patient stare at a blank white wall while wearing red/green glasses and ask them what they see without alternation. They should see both fields. Project a square of white light on the wall and have the patient look at the square. Place a small amout of prismin front of the eye and look for a vergence movement (patient should say the field split and then become one again). Increase the prism to diplopia and then reduce it until the patient is fused again. Repeat this procedure with the patient at an increasingly farther distance.
2. Completely separate the Quioits vectogram slide, with polaroids on, the patient looks straight ahead without alternatingand should be aware of the peripheral awareness. To enhance the effect, place a TBI light behind each target.
3. Remove the Rx. Have the patient wear red/green glasses and look at a penlight. They should either have luster or give the correct diplopia response. Now fog the patient with +20.00 spectacles so they can only use the peripheral sensory. Find out how far you can move the light and still have luster; this is the centration range. Now do jump duction in the centration range.

Therapy for eccentric fixation. Unsteady EF, occlude fixing eye and do monocular work. Steady EF use after image transfer. For a young steady EF use monocular reverse prism 2X that of the EF. For example, a 4^{Δ} nasal eccentric fixator you would use 8^{Δ} BI. ($1^{\Delta} = 2^{\Delta}$ so $4^{\Delta} = 2^{\Delta}$) Thus occlude fixing eye and use 8 BI over EF eye to create a sense of torque. For a temporal EF BO prism is used.

The "good" eye is occluded 5-6 hours per day and the "bad eye" is occluded the rest of the time. Each week you measure the amount of EF. When centra fixation is restored, leave th prism on for two additional weeks. Fresnel prism creates an altered feeling tone while the patient is in physical motion. The prism destabilizes the focus of eccentric points.

Strabismus Workup at Chair Side:

1. If you get true neutrality on the cover test with the prism bar then the patient probably has NRC: but if you constantly get little flicks of the eyes and never get perfect neutrality then be very suspicious of ARC. If you have an ET with alternate hypertropia and latent hyperopia forget about training this patient, you cannot help him! Real divergence v. simulated: If you put +3.00 spheres on at near, the phoria of a real divergence XS does not change but a simulated divergence XS will greatly increase in XO, these people need plus at near.
2. Centration Point

   With the patient wearing red-green glasses find the point at which they have luster. I f you do a cover test here there should be no movement. Now at the centration point with the red-green glasses still on see if small amounts of prism will increase the centration point. Now using a muscle light measure the maximum amount of BI and BO they can compensate for at the centration point; you know their limits.
3. Streak Corrspondence Test

   Have fixing eye look at a target on the wall, place a light in front of the nonfixing eye. If the target is inside the light then the patient has NRC, if not then they have ARC.

4. If #3 shows ARC then repeat under condition of binocular fog. If the target is still separated from the light then this ARC is not correctable.

5. Stick and Straw
   Have the patient insert a pointer into a straw working at the centration point. Do this several times, then just before they insert the pointer place a small amount of prism in front of one eye. Watch to see if the patient gives the correct vergence response and if the hand position changes in response to SILO.
6. 4 BO Test
   If you get a positive 4 BO test then you want to know if peripheral awareness will enhance the test. So do the 4 BO in an open room having the patient be aware of the periphery.
7. Slave- Master Test (as described previously)
8. Project onto the wall the Rabbit N Ring tranyglyph so that the patient sees a rabbit holding a carrot all of which is encircled by a ring. With the patient wearing red-green glasses occlude the red eye, move a green point until the patient reports it is directly below the carrot. Now have the patient look with both eyes, if they report that two pointers are aligned then you can start training in the periphery.

Harmon talked of the body as an integrated mass action system. The torso is for righting functions, the head has the visual system for single vision, and the vestibular system to work against gravity, and the neck is the transductor. Thus, posture can affect vision and vision can affect posture. When there is visual input and vestibular input, the visual input will override all other inputs.

Stockwell spoke of the body as having four links that connect five body areas. The neck, pelvis, knee and ankle connect the head, torso, shank, knee-ankle area, and foot. Every link has torque, and besides having its own torque it has the torque of all the links above it. Thus, the ankle being at the bottom, has the torque of all four links and the neck being at the top, has only its own torque. Since we are not one but a series of parts this can leaf to many postural deviations.

Vestibular Ocular Reflex (VOR)

When there is movement of the head there is an equal and opposite eye movement. This serves three functions:

1. keeps the visual world single
2. prepares for the next visual sensation
3. prevents confusion

The VOR is controlled by three mechanisms:

1. the semi-circualar canals
2. the otolith system
3. cervical input

Procedures for enhancing eye tracking while stationary and moving:

1. With the patient on the balance board and weight evenly distributed, have them track the Marsden ball with their eyes only keeping the head still.
2. Next have them track the Marsden ball with their head only keeping the eyes still.
3. Now raise the ball up so that the patient must tilt their head back 50 degrees. The patient is still on the balance board and the target is above eye level. Again, do with eyes only and then with head only.
4. Next with head still up, move the target off center and turn the head to one side and then the other. Track the target with only the eyes first then with only the head. (eyes still)
5. Return the target to eye level and have the patient hold a weight on one side so that they have to torque their body. Repeat steps 1-4.
6. Tag both foveas with after images. Leave the room lights on and repeat steps 1-5. You can drive the afterimages with TBI lights, the old type which can be clipped onto a spectacle frame.
7. Now repeat everything but in a totally dark room illuminating only the target.
8. Make the room as dark as possible. Have the patient track by visualizing the target. To make it a little easier, flash a penlight somewhere in their field of vision randomly every 10-15 seconds.
9. Now repeat everything with the patient running in place and the training room dim.

VOR gain; a gain of 1.0 means that there is no lag behind the target. The human system never has a gain of 1.0. The VOR is modifiable by experience. The adducting eye always moves faster than the abducting eye. Head movements are more amenable to conscious change than are eye movements.

A common complaint of patients is when they look up greater than 50 degrees, such as when they are working overhead while standing on a stepladder, they feel as if they are swaying and are going to lose their balance. This is called head extension vertigo. When you look up more than 50 degrees you get vertical retinal slip which is interpreted by the vestibular system as body movements forward and backward. With the head raised greater than 50 degrees you are out of range of the otoliths but the visual system is still accurate, thus the two systems are in conflict and the visual system wins out.

Procedure for elimination head extension vertige:

Take a piece of foam rubber approximately 2' by 2' and 4 inches thick and place a piece of plywood over it for the patient to stand on. Have the patient look straight ahead for 30 seconds. Then have the patient raise their head greater than 50 degrees and stare ahead for 30 seconds. Some people may not be able to raise their head the entire 50 degrees at once so raise their head gradually until you get to the desired 50 degrees. Next look straight ahead with the eyes closed for 30 seconds and then with the head back 50 degrees with the eyes closed for 30 seconds. This is a total for two minutes, take a two minute break and then repeat. Continue this pattern for one hour. After one week do the procedure with the head turned to one side. Next do it while tracking the Marsden ball and finally with afterimage tagging.

How does the human visual system determine motion? By time to collision analysis. There are two types of motion detection neurons in the cortex. Y neurons are peripheral and detect movement rapidly but coarsely. X neurons are more central and detect movement slowly and very accurately. On initial movement the Y neurons pick up the movement and then the X neurons take over. So as a target moves from point A to point B there is a constant analysis of the target at two different positions and at two different times. These are special temporal movements. However, each neuron has an excitatory movement if there is no suppression. The previous techniques for eye tracking are used to reduce the suppression tendency. Also see the letter reading and line counting techniques.

Peripheral vision does not require alignment. Strabs can achieve stereo by global stereopsis.

Procedure for expanding peripheral awareness:

1. Continuity of space
   Project the quoits vectogram onto the wall. Have the patient stare at the quoits while you introduce a bi nasal wedge. Lower the bi nasal wedge until you get disruption of the field. Tape the patient's Rx to make nasal occluders in the same position as the bi nasal wedge. Use translucent tape such as 3M #800. The Rx is to be worn for all movement activities, outside and reading. Instruct the patient that things will not be as clear but this forces them to open up the periphery. Eventually the space will become continuous and whole.

2. Stability of peripheral field
   For this you use the AO vectograph slide with the fixation disparity chart; the cross in which the OD sees the upper vertical and right horizontal line and the OS sees the lower vertical and left horizontal line. Give the patient two peripheral afterimages, vertical in the OD and horizontal in the OS. To get peripheral afterimages have the patient fixate a central target then move the flash off center either up, down, left, right. Have the patient look at the fixation disparity target with both eyes, if they have a stable peripheral field the patient will see the afterimages perfectly lined up with the target. Use the TBI to drive the afterimages. Now do vergence with a prism bar, have the patient keep the afterimages aligned with the fixation disparity target. Next have the patient rotate their head in one vertical plane keeping the afterimages aligned with the target.

3. Localization of peripheral field
   With the nasal occluder Rx on or the binasal wedge in place have the patient look at the quoits vectogram. Using BI and BO prisms have the patient do localization, float, and SILO peripherally.

4. Expansion of peripheral filed
   Two ways this can be done:
   a. Build up the largest vergence possible in the periphery using the above technique.

b. Have the patient wear the nasal occluder Rx. Totally occlude one eye. Have the patient hold a transparent chart 8-10 inches in front of them and stare at a black wall. Instruct the patient to accommodate at the plane of the card and try to localize the letters. Now have them relax their accommodation, they will find the letters blur but they will be able to see more letters.

5. Yoke prism

Yoked prism destabilizes the patient, temporal disequalibrium of space world. This arouses the cortex forcing it to attend more thus increasing the number of cortical sampling points.