5-1988

The affects of yoked prisms on spatial orientation and posture of the Cerebral Palsy patients

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Degree Type

Thesis

Degree Name

Master of Science in Vision Science

Committee Chair

William M. Ludlam

Subject Categories

Optometry

The Affects of Yoked Prisms on Spatial Orientation and Posture of the Cerebral Palsy Patients.

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A Thesis Submitted to the Faculty
of the College of Optometry
Pacific University
Forest Grove, Oregon
For the Degree of Doctor of Optometry
May 1988

Adviser:

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Abstract:

The condition of cerebral palsy has been thought of as a chronic situation with no positive change in posture or movement in the patient expected. The recent use of yoked prisms has changed this for many people afflicted with cerebral palsy. The yoke prism affects the brain and has an affect on the posture and orientation of the patient. The condition of cerebral palsy as well as the neurology will be examined in this paper. A prescribing method will be introduced as well as three case studies.

The Affect of Yoked Prisms on Spatial Orientation and Posture of Cerebral Palsy Patients.

Introduction:

The following paper will entail several aspects of prescribing yoked prism for the cerebral palsy (CP) patient, and why this method of prescribing is so successful. Cerebral palsy is a complex condition which should be understood first What part of the brain is affected with relationship to a CP behavior. This will later be correlated to the use of yoked prisms and the effect they have on the cortical areas, as well as prescribing of yoked prism and the method of doing so.

Part I: Cerebral Palsy

Cerebral palsy is a group of clinical syndrome characterized by chronic motor dysfunction, such as paralysis, weakness, uncoordinated involuntary motion, or any other aberration of

movement due to involvement of the motor control areas of the brain.[1]

Cerebral palsy is associated with a condition usually developing shortly before birth, during birth, or within the first few month after birth.[2] The child who is the victim of CP is considered to be in a chronic state of disability which does not worsen.[3] Cerebral Palsy prevalence is thought to be affecting 35% pre-natal, 50% at birth, and 15% post-natal.[4] There are many diverse causes of CP, however four major causes are more prevalent; 55% are due to difficulties at birth including hemorrhage and anoxia, 23% by congenital cerebral affects, 5% post-natal trauma, and 17% of other conditions.[5] These conditions can have differing affects and severity on the patient.

There are several forms of CP, however it is divided into three major catagories.[6] The categories are based on the particular area of the brain that is affected, and type of physical behavior exhibited.[7]

The spastic type is generally associated with a lesion of the pyramidal system and motor cortex. These types of patients make

up approximately 40% of all CP's. The behaviors associated with the spastic are hyperactive reflexes affecting the extensor muscle of the back and legs, and the flexors of the arms. The patient often has rigid movements with the arms pulled tightly upward at the elbows, and in toward the body, while the legs tend to be somewhat bent with the knees pointed inwardly towards one another. The gait of the spastic is generally awkward with the bodies center of gravity in front. The patients ability to grasp is poor often overshooting or undershooting the target.[8]

The athetoid usually have lesions of the extrapryamidal system, basal ganglion, and some sections of the stratum cerebellum. They make up approximately 40% of all CP's as well. The athetoid is characterized by involuntary purposeless movements. There is not a fine adjustment of locomotion or grasping abilities. The gait often is a fast forward movement where the patient seems to have no control of his/her momentum. Generally there is a lot of extra movement associated with this type of patient.[9]

The ataxic type are usually affected by lesions of the

cerebellum, which make up approximately 10% of all the CP's. This patient has an inability to control the coordinated movements of the muscles. They have proprioceptive disabilities which cause awkward and unbalanced gait.[10]

Most individuals with CP are affected in all three categories, however there is a dominant set of signs and symptoms which are used for labeling the CP.[11] The system are often inter linked with each other and seldom is only one section of the brain affected.

The severity of the CP is determined by how the body is most affected, how embedded the difficulty is, and other anomalies that are associated with the patient.[12]

There are four descriptions of body paralysis associated with CP. Hemiplegia in which one half of the body is affected either right side or left. Paraplegia in which two limbs are affected usually legs more often then arms. Quadraplegia in which all four limbs are affected. Diplegia in which the legs are more affected then the arms. There is some argument that monoplegia exists, however most practitioners dismiss this since it seems lesions are not that specific. In most cases of CP the patient is diplegic and often

hemiplegic as well.[13]

The CP is usually affected by a wide range of defects beyond body paralysis. These include spatial and perceptual difficulties (more often seen in spastics). Speech and auditory difficulty in 75% of CP's which may include deafness, agnosia, slurred speech, and inability to understand speech. Mental retardation to some degree in 50%.

Emotional problems are mostly noted in athetoids, reading problems and reading retardation in most CP's. Developmental difficulties which may be due to missing critical periods then the actual CP itself. Visual problems are considered to affect 100% in one form or another.[14]

A yoked prism is not necessarily prescribed for visual refraction, however since all CP's have some visual anomaly the vision problems should be addressed. Most CP have strabismus, 50-65% are affected with a ratio of 2:1 esotropes to exotropes. It should be noted that in the normal population the ratio is 4:1. Approximately 20-30% of the CP's are considered amblyopic which

may be associated with strabismus, optic neuritis, or cortical lesions. Most are affected with a refractive error that is significant, 15-20% are myopic of -.50 or more, 15-20% are hyperopic of +.75 or more, and 45-50% have significant astigmatism of -.75 or greater. Some form of cortical blindness, optic neuritis, or nystagmus is found in 5%. Accommodative insufficiency is considered to affect 100% of all CP's, which may contribute a great deal to the reading problems. Visual perception difficulties are found in 40-50% which include figure-ground, visio-spatial, and visio-orientation anomalies. It is considered that all children with CP have some form of visual defect and that correction of many of these difficulties will have a positive affect of the overall person.[15]

Part II: The Neuroanatomy and Neurology of Cerebral Palsy.

Through further knowledge of the neuroanatomy and reflexes of the brain a better understanding can be made as to how and why a lesion in a certain section of the brain will cause a particular affect. The severity of the condition can be associated

with the damage caused and the exposure time.[16] The signs elicited by the patient often can also indicate the exact location of a lesion.[17]

The pyramidal tracts are easiest to locate in the medulla just below the pons.[18] These tracts have a direct linking to the rolandic cortex (Broadman's area #4) located in the pre-central gyrus. The pyramids aid in the tactile and proprioceptive areas of the brain involved with movement.[19] An affliction of this area makes spatial movement difficult and awkward for the individual. The flexor muscles of the arms and the extensor muscles of the legs and back become contracted.[20] This will cause a spastic tightened walk with movements being unsure and poorly coordinated.[21] A spastic CP patient that is blindfolded will lose spatial ability and the capability of grasping an object in space will be lost.[22]

The extrapryamids lie laterally to the pyramidal tracts and are the efferent tracts of the rolandic cortex.[23] Patients with extrapryamid lesions are more likely to be hemiplegic in which the contralateral side is affected by a lesion of this tract.[24] The patient has a lack of refinement in movement and movements are

purposeless and involuntary.[25] Lesions of the extraprymadals are more likely to affect the basal ganglion in particular the anterior portion of the putamen, and also have an affect on the limbic lobe.[26] Emotional problems are more prevalent in athetoids due to the association to the limbic lobe.[27] The hypothalamus and the pituitary are very often not affected. If the effects on the extrapryamidals is bilateral then often the patient will have dystonia, a condition in which the arms are flexed tightly to the body and the legs are as well.[28] These children are usually severely retarded and have little to no awareness with the exception of gross movement and certain primitive reflexes.[29]

The basal ganglion is in close association with the extrapryamidal tracts and often have accompanying lesions.[30] The function of the basal ganglion is not fully understood, but the feeling is that it is associated with the refinement of movement and sensory input associated with the thalamus.[31] The effects of lesions the basal ganglion is related to the athetoid behaviors and can also elicit wild and loose movements similar to St. Vitus dance in Huntingtons Chorea.[32] These affects can be associated with

difficulties of the lateral and medial geniculate body which relate to visual and auditory problems of CP.

Lesions of the cerebellum produce some form of ataxic behavior in the CP patient. Cerebellar CP by itself is the least common form and is usually associated with other forms of CP.[33] The patient with cerebellar defects will have difficulties in maintaining balance and show poor refined movement. The gait is awkward and movements are exaggerated.[34] There may be effects on eye movements, which affect either saccadic or pursuit movements depending on what area of the cerebellum is affected.[35]

With a mass destruction of the cerebellum dystonia does occur. More often however the patient suffering lesions of the cerebellum generally has the least anomolies.[36]

The righting reflex should also be considered when discussing the CP patient. In the normal person the reflex is used to readjust the body and the body position when he is put out of balance.[37] Under normal conditions we react to a stimulus change by adjusting our weight and stance accordingly. The CP patient usually has a slower latency to a change in motion and will react with

exaggerated movement.[38] The reflex is based on three stimuli which work together to help the body readjust to any change in balance; which are the labyrinth system, proprioceptive stimuli of the joints of the ankle, knees, and shoulders, and visual stimuli.[39] For most people afflicted with CP all three systems are affected and the patient has very poor balance responses. The CP may also be affected by "sway" in which the natural posture is leaning to the right or the left, this may be associated with scoliosis or torticollis, or may eventually cause it.[40] The CP in this condition is already imbalance and the righting reflex is often more grossly affected.[41]

Cerebral palsy is seldom a specific set of signs or symptoms. The lesions generally affect many different centers of the brain, however most CP's can be classed by the dominance of behaviors that are elicited. The behavior that is noted can be attributed to a particular section of the brain and help map out what area is most affected.

Part III: Yoked Prisms how and why they work.

When discussing the affects of a yoked prism the under

standing of the visual system, and how it affects the posture is necessary. Approximately 80% of the visual fibers from the eye relate to the visual cortex and areas of eye movements. The other 20% go to deeper cortical areas and have an effect on posture and spatial orientation.[42] The visual fibers are identified as X,Y,and W types. The X fiber apparently is associated with central retinal activity, and approximately 100% enter the LGN. The Y fiber is more associated with the peripheral retina, and fibers go to the LGN and the optic tectum and superior colliculus in which auditory and visual stimuli interact. The W fiber is poorly understood and little is known as to its function, however there is a possibility that the W fibers are associated with the spatial and postural visual effects of the human.[43]

The visual system plays a major role in understanding where we are located in space. We use distance ques, figure ground, and visual clarity as cues for orientation.[44] Vision is also a main component in movement, and is needed for smooth movement through space.[45]

The use of lenses on humans will cause an effect on the

posture and spatial orientation.[46] The type of lens and the power of the lens can have a great effect on postural stance. A plus lens will cause a hypotonicity or relax the muscles.[47] The minus lens has the opposite affect.[48] The reason for this phenomenon is the way light is moved across the retina. The light causes a neural input to the brain which processes the stimulus and reacts to it.[49]

The use of the yoked prism will cause similar effects on the system. The base-up (BU) prism causes light to be bent toward the base thus the image is displaced toward the apex and the eyes turn down toward the apex.[50] The base-down (BD) produces the opposite affect. The point is that light is bent toward the base and the image is displaced toward the apex. In a BD prism the general view is shifted upward and outward it gives the impression of being at the bottom of a hill. The BU prism shifts the view downward and inward, or the impression of standing on top of a hill.[51]

In the case of CP most patients suffer from the following postural affects: the center of gravity is in front of the patient, the extensors of legs and back and the flexors of the arms are

contracted, and forward movement is awkward. The CP patient has exaggerated movements and poor balance controls. The use of a yoked prism has an effect on all of these factors.[52]

There are three major ways in which the yoked prism effects the postural stance of the CP patient. The Yoked prisms can elicit a response to relax muscles, make a change in the pelvis, and has an input stimulus to the to the locus coerleus.[53] All three of these factors are of value to the CP patient.

In an earlier section of the paper it was mentioned that the plus lens causes hypotonicity of the muscles and that the minus lens causes a hypertonicty. The yoked vertical prisms have similar effects in which the BD correlates with the plus lens and the BU with the minus lens.[54] For most of the CP patients the BD prism tends to be the prism that works the best. The use of the yoked BD prism causes the extensors of the legs and back, and the flexors of the arms to relax. This process relieves some of the rigidness of the body which allows more freedom of movement.[55] The use of the BU prism is not as common, however in cases where the patient has rigid flexors of the back the BU prism tightens the extensors and

ultimately relaxes the flexor muscles. allowing the patient to stand up straighter.[56]

The use of yoked prism will cause a shift in the pelvis which causes a change the center of gravity.[57] The yoked BD prism causes the pelvis to shift downward and the center of gravity to shift backward.[58] In the use of a BU prism the opposite effect happens, and again the choice of lens depends on which direction you want to move the center of gravity. A point to remember is that the direction the eyes are shifted is opposite that of the direction the pelvis is shifted.[59] The combination of shifting the center of gravity and relaxing certain muscle groups interact well together. The rigidness of the back extensors force the CP patient to be bent down and forward it also affects the pelvis by pushing it into an upward direction. The application of a BD yoked prism will change that particular posture.

The last effect on postural change is the stimulus affect on the locus coeruleus. The locus coeruleus is a small section of the reticular formation.[60] It is located in the anterior floor of the fourth ventricle superior to the sulcus limitus, lateral to the medial

eminence, and anterior to the cerebellar peduncles.[61] It is felt by many scientists that the locus coeruleus is a determining factor which controls of what and how much sensory signals come through.[62] The CP patient suffers from a lack of sensory feedback, which makes space relations uncertain or when end point of movement has been reached.[63] It is believed that yoked prisms and BD in particular have a smoothing effect on sensory signals via the locus coeruleus. The actual reasons for this effect have not been discovered yet, but it is felt that the catacholamine system is involved. Light effects across the retina may have some direct correlation.[64]

When applying all three effects of yoked prisms on the CP patient postural changes can occur which enable the CP to maintain a more normal posture.

Part IV: Prescribing Yoked Prisms for the Cerebral Palsy Patient.

When prescribing the proper yoked prism many aspects must be considered for the best possible results. The visual anomalies

associated with CP should be considered before prism application is considered.

As stated earlier 75-80% of CP patients have refractive errors. Before a yoked prism is prescribed the refractive error should be corrected for the best VA possible or best lens for the conditions.[65] The resultant lens not only corrects the error, but may have some effect on the musculature as well. The minus lens can cause more rigidness and a plus lens will reduce the muscle contraction. The combination of the spherical lens may aid or counteract the affect of the yoked prism. When determining how much prism power to prescribe the type of correcting lens may have an effect.

The high incidence of strabismus in CP's should also be a determining factor in prism prescribing. The refractive error should be considered first, because of the possibility of accommodative esotropia or some other condition due to accommodative infacility.[66] The practitioner may choose to add prism to reduce squint and increase binocularity.[67]

Following the correction of the refractive error and best possible strabismic lenses, then an evaluation on prescribing the

yoked prism will follow. It should be remembered that yoked prisms are not used for correcting visual acuity, strabismus angle, or any other direct visual defect. The yoked prism is to prescribed for postural and spatial affects, with the goal of improving such postures.[68] With a positive prescription the CP patient should have smoother movement and a more relaxed even gait.

When determining the yoked prism to be prescribed the following observations should be made. Watch the patients gait (how they move) and the postural stance. Then try certain yoked prisms and watch the reaction of the patient, note whether the patient has relaxed or tightened up. Use near retinoscopy to determine the brightest reflex. Finally see what happens with the prisms on.

The patient should be observed for certain behaviors that would warrant a particular yoked prism. The general condition of most CP's is a center of gravity in front of the body, rigid muscles with tight movement, and spatial localization difficulties. When a patient presents with the following syndrome they are usually most benefited with a BD yoked prism.[69] If there is an unusual

arch in the back then the BU prism is indicated. A point that must be recognized is that a patient may be in an opposing reflex or over accommodating of a specific condition. ie. The arch back may be due to readjustment by the patient to overcome the rigid extensors of the back, and a BD prism will be the more appropriate lens of choice.[70] The sway of the patient should be considered as well. The yoked prism is usually prescribed with the base towards the sway.[71]

When fitting the prism it is best to have the patient in the lap of the parent or a therapist if the child is small. The reason for this is so the parent can actually feel the child's muscles loosen or tighten up the practitioner should observe this as well.[72] If a positive result, occurs then the prism is correct for this patient.[73] ie. The patients posture indicates that a BD prism is appropriate, when the prism is applied the patient reacts with relaxing the muscle the rigidness decreases. This should be the prism of choice to double check, a BU prism can be applied. If the patient reacts by getting more rigid then the BD is the right choice.[74] After the prism has been chosen then the practitioner can rock the prism to

find the maximum angle that will give the best results.[75]

The proper prism can be checked by use of near retinoscopy, as well as the prism power to be prescribe. Bell retinoscopy is often the best choice of retinoscopy mode, because the patient does not need to be auditory, literate, and the stimulus that can be used will aid in better fixation.[76] When the refractive error is corrected and the prism power is correct then a bight yellow-orange reflex is usually observed.[77] Observation of the brightness of the reflex is most important. The patient would be corrected refractively and you should expect a neutral motion or slight with motion. The brightness of the reflex will indicate whether the prism power and axis are correct.[78]

The power of the yoked prism is usually 3-5^.[79] The amount of prism power needed is not truly understood at this time, however certain lens powers may effect the necessary prism power. The refractive error is a contributing factor in that the correcting lens may work with or against the prism prescribed. This is because of the tonicity affects brought on by lenses.[80]

Once the lenses have been applied then the patient's reaction

can be observed. These lenses usually have a profound impact on the patient, and even though the spatial and postural affects are nearer to normal, the patient needs an adjusting period.[81] This period is different for everyone. They also must get used to the new world that they have been introduced to. Fortunately most people with CP are in therapy programs which can help train the patient to the new prisms. There is not significant data as to whether the yoke prism is only a transient affect, or if patients will "eat" more prism to maintain the effects.

The patient can truly be helped with the application of the yoked prism.

Part V: Case Studies.

During the summer and late fall of 1987 I was on a private preceptorship in Dr. Dorothy Parrot's office in Lakewood Colorado. During this time I observed and applied yoked prisms to three children with cerebral palsy.

Case I: Katie M. 5y/o female ambulatory

refractive error OD +4.0-1.0*88 20/30 OS +4.25-1.50*93 20/30

no strabismus observed through cover test while wearing glasses. Accommodative infacility through +_1.25. No amblyopia. Perceptual tests were below expecteds for her age. The shape puzzle time and orientation were slower.

Physical manifestations: Hemiplegia on right side paraplegia of lower limbs. The right leg was the most affected limb. Noted sometimes dragging of the right leg when walking.

Mental abilities: IQ just below normal Has been main streamed in kindergarten class with a few special courses.

Katie has been wearing a full Rx for the last two years. Upon examination a 3^ BD and BR approximately @ 30 degrees was applied

Results: Katie is an outgoing personality which was not effected by prisms. Immediately upon prescribing of prism it was noted that the right leg did not drag as much movement was smoother and less hindered. She stood up straighter and placed more weight on the right leg. Katie was seen 3 times over the next 6 months. Her right leg had gotten stronger and the gait was almost normal. She is completely mainstreamed in all classes including P.E.

Case II: Michael A. 8 y/o male nonambulatory

Refractive error: OD +3.50-1.5*175 20/40 OS+3.00-1.0*08 20/40

Acuities are a best guess from bell retinoscopy. Cover test inconclusive due to pendular nystagmus and lack of fixation abilities.

Physical manifestations: Dystonia of all limbs. The body was locked in tight in the fetal position. Sway noted to the right

Mental abilities: Lack of awareness no signs of processing. institutionalized.

Michael was prescribed the full refraction and 5^ BD and BR approximately 45 degrees.

Results: Upon prescribing the prisms there was a relaxation of the entire body which was noted by the grandmother, Dr. Parrott, and myself. In the months that followed the grandmother insists that he is more aware of his surrounds.

Case III: Tom A. 13 y/o male ambulatory

Refractive error: OD +0.75 sph 20/25 OS +0.50-.25* 180 20/25

Alternating exotropia noted mostly by end of day. Accommodative infacility through +-1.75 Typical perception problems

Physical manifestations: Typical spastic posture with speech impediment.

Mental Abilities: IQ considered normal. With exception of perceptual problems was in good shape. Presently mainstreamed, he does take special reading courses and is doing well.

Tom was prescribed +0.50 sph. OU and 4^ BD prism.

Results: Seen immediatly the center of gravity moved backward a few degrees, the muscles relaxed, and spatial abilities seemed more intact. Tom is in the V.T. program and is seen weekly. About a week after the prisms were prescribed Tom ran for the first time. He plays basketball at home and is much more physically active.

Conclusions: Case studies.

We were working with a small population, but the results over the six month period are encouraging. It only takes a small amount of yoke prism power to produce changes in the posture and spatial orientation of these children. In the time that these subjects were observed there was no signs that a more powerful

prism was necessary to maintain the progress noted in these children.

Further research is necessary to evaluate the full effect of the yoked prism on the CP patient. It is important to know what is the reason for such a lens to cause such a dramatic effect on the patient, How it affects the motor cortical areas of the brain and at what level. Studies on how the prism is accepted or whether the patient will need a more powerful prism with time to maintain any improvements elicited. And finally how far can we go with the success of the yoked prism on the cerebral palsy patient.

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