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The Influence of Postural Control on Functional Vision Efficiency

by W. Michael Magrun, M.S., OTR

Learning Outcomes
The Participant Will be able to:
1. Describe the relationship between postural control and visual efficiency.
2. Describe the importance of postural assessment prior to visual intervention strategies.
3. Identify musculoskeletal factors that can interfere with functional vision efficiency.
4. Identify the benefits of combining physical handling with vision intervention.
5. Describe the "Fulcrum Concept."

Introduction

The goal of visual-motor intervention is to match the visual and postural systems for the best resultant functional performance. Just as vision therapy can change postural reactions and improve postural efficiencies, postural intervention can change visual function and improve visual efficiency. These two systems must be simultaneously appreciated, assessed and treated for the best possible outcomes. There must be a progressive re-matching of the visual-postural systems toward an ever increasing efficiency.

Vision is often characterized as the primary sensory system that leads movement and provides spatial-temporal orientation. As such the visual system is regarded as the major system involved in functional performance. Although the development of sensorimotor function is very much related to visual function, the visual system is not solely responsible for developing efficient sensorimotor function, either developmentally or in rehabilitation of various acquired motor disorders. Vision drives movement and provides an impetus to move, however it does not create movement. It is an initiator of movement but does not completely control the postural organization required for movement. Vision initiates postural adaptation. The ability to adapt is a postural function.

To a large extent the visual system is dependent on postural development. Postural control allows the visual system to become a primary sensorimotor initiator. In rehabilitation of acquired or developmental disorders, the visual system is dependent on the ability of the postural system to adapt and re-establish a functional foundation.

Distorted vision and other functional vision deficiencies do result in inefficient and abnormal postural responses, however without postural intervention in specific areas, visual intervention alone cannot completely ameliorate the dysfunctional condition, and may in some circumstances contribute to more musculoskeletal and postural-functional inefficiencies.

Take for example a child or adult with tightness in a limb. Pulling on that limb results in more activation of the tightness or spasticity. It provides resistance to the abnormal kinesiology and therefore increases the problem; even strengthens it. The same can be true in visual intervention. If prisms and lenses are used to establish a different perception of space and therefore drive the body to make postural adjustments, the result could be to increase postural inefficiency. If the postural system cannot respond due to tissue or joint restrictions, or dysfunctional postural patterns that are dominate, the new visual orientation may provide an increase in resistance to the postural system, thus potentially strengthening and embedding dysfunctional postural compensations.

The reverse can also be true. If the visual system does not adapt to the therapeutic changes in postural organization, the postural changes may not hold. Further, if the mismatch in postural-visual adaptability is too great, the postural changes facilitated through physical handling may place too much stress on an inflexible visual system, thus locking the visual system more into its dysfunctional range.

Function does not happen without a foundation. Reach and grasp does not happen without a foundation. Sitting, standing, walking, climbing stairs, does not happen without a foundation. Visual pursuits. motility, binocularity or ambient visual organization do not happen without a foundation. To understand how to enhance, develop, or rehabilitate these functions, it is critical to understand the foundation of function that is necessary for efficiency.

Any intervention, whether visual or postural must be identified in terms of establishing the foundation for function, with the understanding that the interaction and matching of the visual-vestibular-somatic systems provide the foundation for function.

Often in rehabilitation of both developmental and acquired disabilities, the various professionals see the problems in isolation of this functional foundation. Visual inefficiencies or distortions are seen as visual problems. Postural disabilities in tone or musculoskeletal factors are seen as physical problems. In the vast majority of cases, neither approach will succeed to the most optimal outcome without an understanding of how to integrate both systems and fully analyze how the inefficiencies of one system impact on the other.

Vision cannot lead normal movement without a normal postural foundation. And vision alone, in cases of physical disability is dependent on the flexibility of the adaptive range of the postural system. Vision will drive postural reactions, however, without an intact adaptive postural system, that drive may reinforce inefficient visual-motor function. As a result, the visual system can also develop inefficient motilities, pursuits and ambient awareness based on the postural restrictions of the disability.

We have two options in treatment. Treat within the range of dysfunction and make dysfunction more "compensatory," or treat by expanding the foundation and fundamental basis for adaptive and progressive efficiency and learning.

How the Development of Postural Control Establishes a Foundation for Visual Function

At birth the infant is in physiological flexion. The distribution of weight forward initiates head turn to clear the airway. This weight also provides compression into the neck and shoulder girdle. A physiological principle in development is that where the weight goes, function develops. The neck and shoulder girdle, through surface contact pressure and resistance of gravity, begin to develop muscular strength. At this point the visual system is not able to organize far reaching spatial awareness. The neonate can see high contrast such as black and white at a distance of 7-9 inches. Only when postural development of neck control, shoulder girdle stability, thoracic control are established over the first few months, does the visual system begin to have a foundation for function. Postural development leads functional vision development.

In fact, children with visual impairment (blindness) develop at a normal range over the first few months. In the normal infant the optical righting and labyrinthine righting reactions are well established at 2 months, evidenced by the near absence of head lag.(1) The increased strength in the neck over the first 2 months allows for the head to react to these righting reactions.(2)

Vision begins to activate postural responses due to the postural foundation of head/neck control. The visual system is highly dependent on the neck which is critical in the organization of sensory processing for motor performance. According to systems theory (3) at about 2 months, coordinated neck musculature action for posture is present. This is followed by the mapping of the visual system to the neck musculature, followed by the mapping of the somatosensory system to the neck, followed by mapping of the vestibular system to the neck. This priority for mapping is significant for understanding the influence and importance of each sensory system to postural control and each other. As neck control develops it activates the upper thoracic spine and allows the visual system to orient to a stable base of support thus providing the opportunity for ambient and visual processes to organize and match to somatosensory and vestibular information. Without this supporting postural framework skilled motor control is inefficient, and compensatory dysfunctional motor control is embedded. (4)

Falla, et al, (5) concluded that feed-forward activation of the neck muscles was necessary to achieve stability for the visual and vestibular systems, as well as ensuring stabilization of the cervical spine. Normal healthy subjects were tested during rapid arm movements and EMG onsets were calculated for the sternocleidomastoid and cervical muscles. Flexor and extensor cervical muscles showed co-activation and during bilateral and unilateral perturbations the sternocleidomastoid and cervical extensor muscles demonstrated feed-forward co-activation. When we think of individuals with inefficient stability of the neck, it is not hard to understand how visual and vestibular processing can be affected.

As a result of brain injury, the CNS presents dysfunction in posture and movement. Alignment of body segments is altered which results in abnormal postural tone, imbalances in weight bearing, and disruption of stability-mobility factors necessary for coordinated function. The neuro-postural base is compromised and in the presence of visual dysfunction an inefficient matching of the visual-vestibular-somatosensory triad is the result. Efficient righting responses and balance and equilibrium responses cannot refine automatic postural adjustments, therefore movement lacks quality and deteriorates with continuous attempts to respond to a motor task with visual distortions.(4)

Assessment of the individual that has suffered insult to the brain must take into account the intricate relationships between posture, movement and vision. Posture and movement control cannot be separated from vision. Vision cannot be separated from the organization of posture and movement. Efficient matching of neural systems results in efficient learning and sensorimotor function. The adaptability of each system is critical to understand. Changing the adaptability of one system "unlocks" compensatory inefficiencies and allows more dynamic interaction between these systems for improved skilled performance. (6)

In individuals with brain injury, the musculoskeletal and visual systems respond inefficiently to each other. Postural adaptation to visual distortions are faulty. Visual adaptations to postural restrictions are faulty. The input is faulty and the response is faulty. The faulty proprioceptive input affects the interaction of ambient and focal visual processes. The supporting surface and the horizon do not match visually or proprioceptively. The body tries to adapt and meet the perceived location of the supporting surface resulting in balance and postural deficiencies. The created mismatch immediately causes postural distortions which in turn create tissue restrictions. The visual system must balance ambient and focal processes and the musculoskeletal system must maintain normal alignment that allows for more normal postural tone to enable efficient postural adaptations. (7)

Alignment is critical to efficient functional outcomes and allows the ambient and focal processes to relate to each other and to spatial orientation. Normal alignment provides the foundation for the organized initiation of movement within the demands of visual-spatial orientation (8) Crutchfield and Barnes (9) suggest that alignment is the most critical factor in successful motor control and structural integrity of the musculoskeletal system is the first issue that should be addressed in order to maximize functional potential. Moore (10) emphasizes that vertical alignment is the optimal alignment for organizing sensory-motor processes. Therefore the quality of the movement response is directly related to the quality of the starting posture. Any activation of movement from a misaligned starting position will result in compensatory and abnormal or inefficient motor responses thus exacerbating the mismatch of neural systems. (11)

An attribute of normal CNS function is the calibrating and recalibrating of responses, in such a way that the readiness of a movement happens before the movement is initiated by the matching of vision and posture through the ambient visual process. This does not occur at a conscious level. It is anticipatory to the actual movement initiation. That is why collapse of the ambient process is so debilitating to normal function. Over focalization of the visual system or ambient visual distortions alter visual perception, but it also has the possibility of affecting individuals emotionally through perceived distortions in the environment, making them feel insecure and fearful of moving. (7)

Rehabilitative visual intervention should begin with analysis of postural misalignments and structural shifts. In designing an intervention plan, the interaction of both the visual and postural systems must be considered. Once the individual is in the most erect posture against gravity that can be sustained with or without external aid, visual intervention strategies incorporating body movement components can be more effectively initiated.

Postural Analysis and Vision Function

Postural analysis is imperative, either prior to or simultaneously with the use of optical devices and vision therapy procedures. Without correcting alignment issues vision intervention, particularly with the use of prism lenses can result in more postural disorganization or musculoskeletal dysfunction. Anyone who has taken a wheelchair seating and mobility course understands that knowledge of the clients physical musculoskeletal adaptability is critical in designing a seating system. Forcing a child into a seating alignment that the body cannot accommodate to, can causes pain and orthopedic stress. The same concept holds for using prism lenses to change the perceptual orientation of space and midline. If the body cannot physically adjust to those demands, physical postural dysfunction becomes more embedded and furthers the postural-visual mismatch.


In this example it is clear that a critical factor in how the eyes relate to space is dependent on postural alignment. On the left we see a child with neuromotor disorder unable to activate her pelvis against the base of support. This inhibits active trunk extension and thus core stability for the head and neck to align and allow the eyes to visual scan with unlimited dissociation. It is clear that visual function is limited in terms of motility and scanning and saccades. On the right we observe a normal child with erect posture and active alignment of pelvis, trunk, shoulders and head and neck. The ability to use all fields of vision is unimpaired and the visual system has the postural base of support to be functionally efficient.

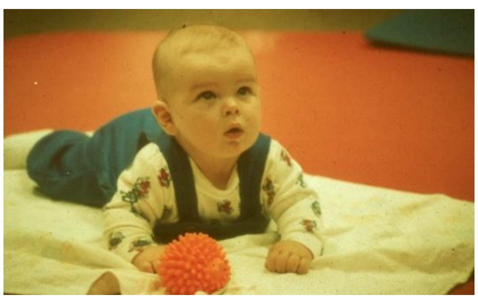

In this example (left photo) activation against the base of support with postural control allows the child to easily orient his head to allow visual regard. Posture supports visual function, and vision can lead postural adaptation to match the postural-visual systems for a functional outcome. On the right we can appreciate how physical disability inhibits any variability or adaptability in visual function. Even though visually the child may see the object of intent, it is impossible to activate a postural response. Lack of physical-postural development affects the development of efficient visual function.

For example, in order for visual pursuits to cross midline the rotational component of body movement is facilitated both in the neck and at the trunk. Once eye movements have full range, ocular pursuits have the potential to be disassociated from head movements as well as to have stability of head position during the pursuit movement. The same approach is used to establish efficient saccades. In order for this to be precise the head has to be stable so the eyes will shift in regard, at high velocity, to the target with accuracy and control.

Likewise the components of body extension and flexion should be incorporated to assist in convergence and divergence. In early development the organization of basic movement components yields refinement of movement against gravity. The baby in prone at 3 months of age shows neck extension and head-neck-shoulder girdle stability sufficient for the eyes to converge and develop binocular fixation and track past midline.

Graded flexion and extension components of movement are often inefficient in individuals with traumatic brain injury and children with neuromotor disorders, and this inefficiency can cause difficulty in convergence and divergence, as well as an imbalance of the use/overuse of specific visual fields. This can result over time in limiting visual adaptation of focal and ambient processes. This is most easily understood by comparing the visual adaptation to posture in normal babies to children with developmental disorders.

In prone for example babies develop the ability to raise the head in extension. This extension is balanced by thoracic flexion and neck elongation, such that the head is stable in an upright alignment but without neck hyperextension or head dropping due to the lack of stability. The result of this postural control allows the eyes to experience adaptations to postural sets. The eyes can look up and down, side to sides and lead subtle adaptations of head orientation and postural control. Likewise the eyes have the opportunity to experience various degrees of vergence and control of various fields of vision within postural adaptations.




At 4 months the child is able to control head movement with graded flexion and extension providing dynamic stability for the eyes to align and adapt to various visual orientations.

When a child has an inability to dynamically control postural adaptations, they develop extreme compensatory stability postures. For example hyperextension in prone of the head and neck or collapsing into flexion causes compensatory visual adaptation. The eyes must overuse the inferior and superior visual fields to attend visually because there are no corresponding postural adjustments.

On the left we see a child who props in prone with hyperextension of the neck and capital extension of the head. This posture is not dynamic and there is limited visual-motor adaptation. On the right we see a child collapsed into the surface unable to posturally maintain normal prone extension. This posture severely limits visual experience. Abnormal postural control leads to the development of abnormal or inefficient visual-motor development.

Postural adaptations become extreme because posture is used only for stability not dynamic movement and control. The child cannot smoothly raise or lower the head. There is a no graded flexion or extension. Posture becomes an all or nothing process. Thrusting into extension or collapsing into flexion. The effect on visual development is profound because the eyes cannot make adaptations within graded postural changes. Graded postural changes allow for experiencing various degrees of freedom of eye movements. Without this experience the eyes simply stop organized visual pursuits or orientation until the next extreme postural stability position is attained.

The visual-motor experiences and synergy of vision and posture are quite different in the following examples.

On the left we observe a child with a low tone. The trunk that does not provide central core stability and therefore he requires a wide base of support. Trunk rotation is therefor limited and the ability to posturally orient and use vision in various postural orientations is limited. On the right we observe a child who has dynamic trunk control that allows for graded rotational movement transitions to reach and visually orient in a wide range of positions.

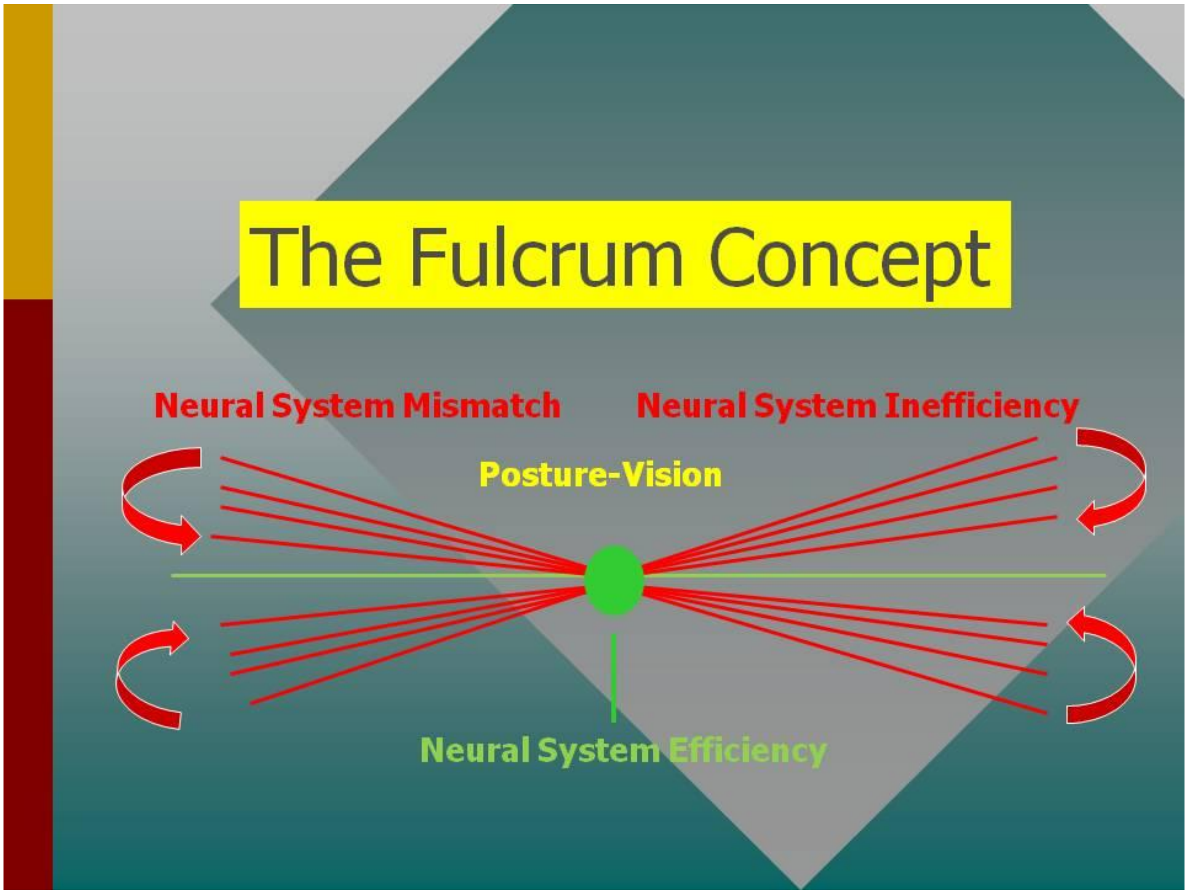
In this comparison we observe a child in supine with low tone unable to activate or initiate flexion against gravity. His efforts to move result in extension into the surface with neck hyperextension. This position compromises the ability for visual pursuit and orientation and posturally confines his visual experience and development. On the right is a normal infant with postural control in supine. This allows viusal orientation to space, and provides the opportunity for the eyes to deveop visual pursuits, saccades and focal vision processes.


In this comparison we again observe the differences between children with and without central core stability, and how that affects the experience of the eyes to engage the environment and effectively lead movement.

All of these examples illustrate the critical importance of postural control to the development of efficient functional vision. Postural control of the head and neck develops through early experiences in prone and supine that provide a stabile base of support for the head, and therefore the ability for eye movements to develop and dissociate. Without this early postural development visual function cannot develop normally or efficiently lead movement which contributes to further postural development.

In individuals with traumatic brain injury the compensatory post trauma experience is similar. There is often no longer normal postural alignment or visual alignment. Postural adaptations are not smooth or graded but compensatory with extreme shifts to different postural stability points. The visual system cannot respond adequately to these postural shifts, especially if there are visual distortions, midline shifts, and visual field impairments. Postural alignment is an important aspect to visual function. For visual function to be dynamic, postural alignment must also be dynamic through the ability to efficiently organize flexion-extension-rotational components of movement with visual intent and adaptation.

The Fulcrum Concept



The Fulcrum Concept is a way to pictorially think about the inter-relationship of the postural and visual systems. For efficient sensorimotor and visual-motor function, these two systems must be in integrated and support each other with confirmatory cooperation. Neural information from each system must match the other for cooperation and interaction to take place.

As has been previously discussed, the development and efficient functionality of each system effects the development and functionality of each system. The visual and postural systems must be in tandem cooperation.

When these systems are out of balance with each other, or stated another way, are in mismatch in terms of how each system reacts to sensorimotor information, the result can be functionally debilitating, with each system competing against the other for dominant control of movement, posture and vision.

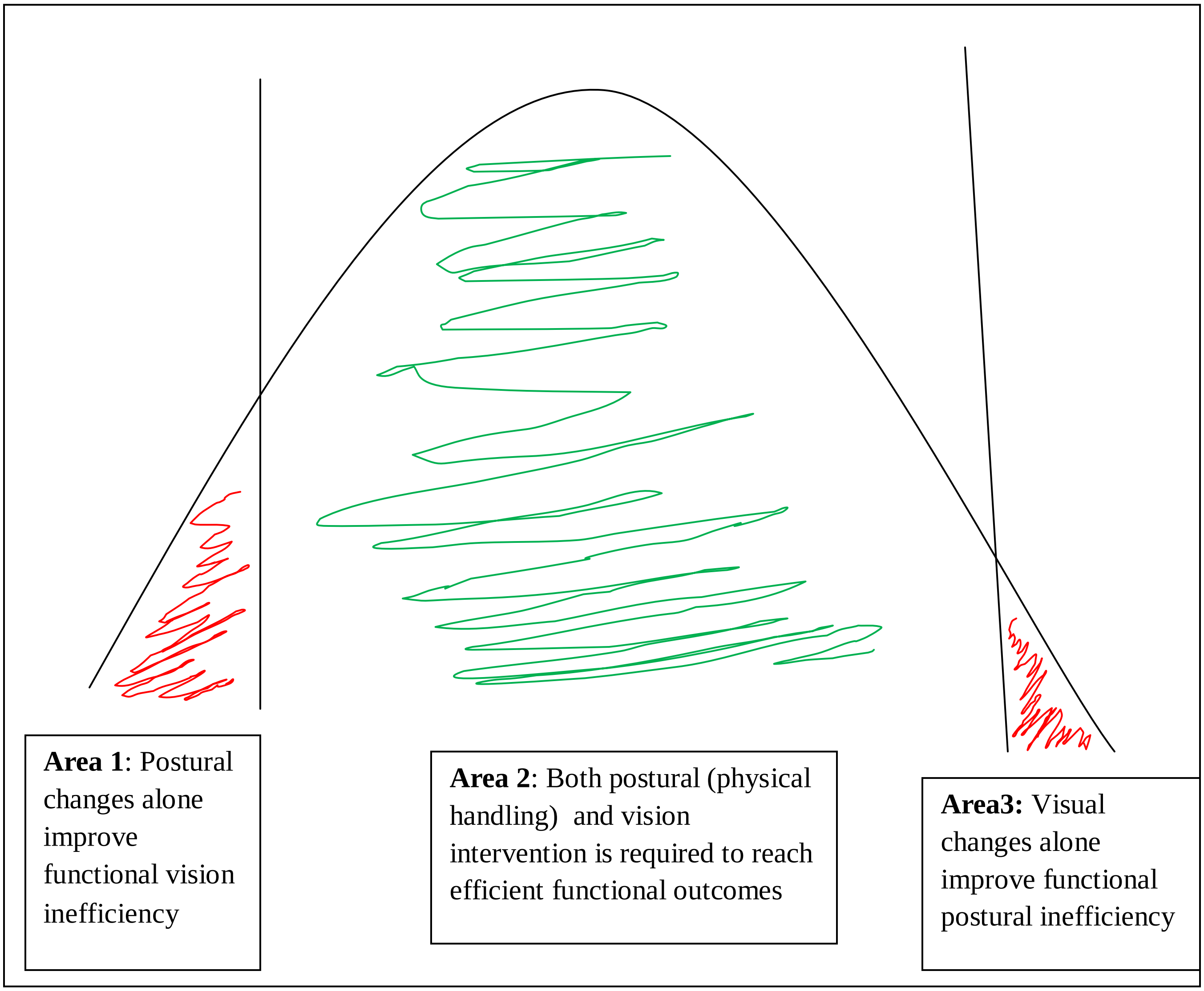
As previously stated, vertical alignment places each sensory system at its optimal position for functional efficiency and matching. When the visual and postural systems match, function is efficient. When they don't, function is inefficient. The degree of inefficiency varies with the degree of dysfunction in each system. Both visual alignment and postural alignment are critical for integrated function.

In cases of significant visual dysfunction as the primary issue, such as visual distortions, visual midline shifts, and post traumatic vision syndrome, (12,13) the perception of space is altered such that the individual may perceive space to be tilted or shifted away from true midline. Due to the significance of the visual distortion, the postural system reacts to match that perception of space causing varying degrees of postural compensations and misalignments resulting in inefficient movement control. The strength of the visual dysfunction causes posture and movement dysfunction.

In cases of significant physical disability as the primary issue, there is an inability of the postural system to maintain dynamic alignment due to musculoskeletal deformities, joint or tissue restrictions, muscular tightness or low tone. Developmental movement and postural disorganization, affects how the visual system tries to align with postural orientation. Because the postural system has limited adaptive capability the visual system must compensate to a distorted postural alignment causing limitations or lack of optimal efficiency in functional vision processes.

Significant dysfunction in one system results in compensatory inefficiency in the other system. However, it is rare that only one system, visual or postural, is affected. In most cases there are both visual and postural issues that require remediation to re-match vision and posture for optimal efficient and adaptive function.

Using a bell-shaped curve we can more clearly understand the effects of vision on posture, and posture on vision as the means to completely change the other as seen in area 1 and 3. In area 2 is the vast population that has varying degrees of visual and postural disorders that are an interrelated process. Sometimes vision has a more predominate role and sometimes posture does. It has incremental degrees that require skilled clinical problem-solving. No vision program alone or no physical handling program alone can achieve maximal efficiency of function. The degree of emphasis on vision or posture in relation to the other is dependent on clinical skill not protocol. Only in the extremes of the curve does one approach work exclusively.


Area 1: Postural changes alone improve functional vision inefficiency
Area 2: Both postural (physical handling) and vision intervention is required to reach efficient functional outcomes
Area3: Visual changes alone improve functional postural inefficiency

Example Area 1

Initial After 2 weeks

Initial alignment shows elevation, and protraction of the shoulders. The mid trunk is inactive with shortening of the trunk on the right side, and uneven weight distribution to the left. The scapulae are not well aligned with slight winging due to inactive scapular adduction. The neck is shortened. After 2 weeks of physical handling treatment significant improvements in postural alignment can be observed. There is more neck elongation. Weight is more equally distributed to both sides. The trunk is more even with the shoulders and scapulae more aligned. The mid trunk with scapular adduction is more active.

Initial After 2 Weeks

Initial attempt at left side one foot balance shows trunk lean to the right without active elongation on the left side. The head comes forward with shoulder elevation as compensatory stability. The right leg flexes and adducts to brace with the left leg for stability.

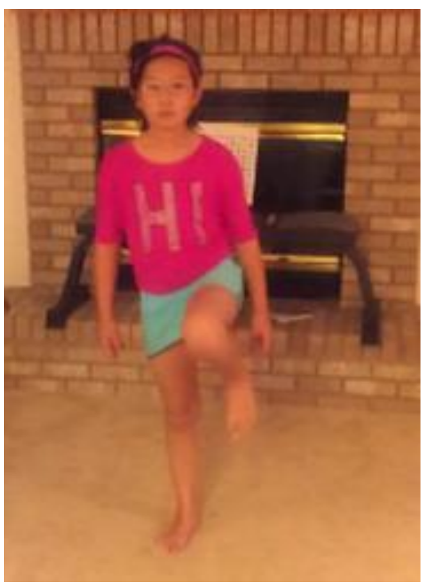
After 2 weeks of physical handling treatment one foot balance is significantly more stable with elongation of the trunk on the left side. The shoulders are aligned with the head-neck-trunk. There is smooth elevation of the right leg without bracing.

In this case this child was treated daily for 2 weeks with neurodevelopmental physical handling. His trunk stability, shoulder- head-neck alignment and balance improved as can be seen. His teacher called and told the treating therapist that his reading grade improved from a C to an A in two weeks. This is an example of organizing postural control and alignment of the head-neck and shoulders that allowed the visual system to function more efficiently.

Example Area 2

Initial After 2 Weeks

Initially, in supine flexion posture, there is dropping of the head and elevation of the shoulders as compensatory stability due to a lack of active abdominal control to flex forward and stabilize on the pelvis. After 2 weeks the head is aligned and the shoulders no longer need to elevate for stability due to more active abdominal control and pelvic aedaptability tothe surface.



Initially in right side one foot balance, there is not active elongation of the trunk on the right. The trunk leans to the right placing the shoulder outside the base of support. There is excessive forward flexion of the left leg with slight adduction. After 2 weeks the trunk is more actively elongated on the right side with the shoulder and hip aligned over the base of support. The left leg is easily lifted off the floor without excessive flexion or adduction.

In the above case this child was under optometric care and vision therapy for over a year. Her visual and postural function improved, however there were still observable postural inefficiencies. After a 2 week intensive neurodevelopmental physical handling therapy program, her postural efficiency improved as can be seen, and her optometrist was able to reduce the prism diopter of her prescription from 9 to 3, in just two weeks. This is an example of the critical need in most all cases for skilled combination of physical handling and vision therapy.

Example Area 2

Initial After Several Months

Initally there is a total lack of good trunk control. The right shoulder is outside the base of support. The trunk is passively leaning to the right. The shoulders are elevated and the head is dropped and leans to the right side outside the base of support. After several months of physical handling treatment the results are dramatic. The trunk is elongated on the rght. The shoulders are aligned over the base of support and the head maintains vertical alignment.

Initial After Several Months

Initially prone extension is inactive. There is no active trunk extension. The head does not extend and the legs remain on the surface with flexion at the knees. After physical handling treatment, the response is smoothly graded with extension of the legs and arms with the head extended normally.

In the above case, after initial screening assessment of the child's postural disorganization and identification of possible visual midline shift and eye motility jerkiness, a referral was made to a developmental optometrist. The child was fitted with prism lenses to address the visual issues. Physical handling treatment was then initiated with the prism lenses. This case is another example of addressing both postural and visual dysfunction simultaneously for a positive outcome.

Example Area 3

(Photos by permission of the Padula institute of Vision)

Without Prism Lenses With Prism Lenses

This young man suffered a closed head injury resulting in extreme visual distortion. His perception of space was altered. He experienced the floor being tilted and his subsequent postural reaction was to try to match a distorted visual perception in space resulting in extreme leaning to the right. Once fitted with prism lenses to correct his perception of space, he was able to regain postural control and easily control his balance and movement.

In this case the use of prism lenses completely changed his postural control due to the primary cause of visual distortion being corrected. He had no postural or musculoskeletal involvement, thus he was easily able to adapt his posture and movement to the more normal visual orientation to space.

Both area 1 and 3 cases are rare. The primary responsibility of the clinician is to problem-solve area 2 and use the fulcrum concept to understand the required emphasis and interrelationships, to integrate both the physical and vision approaches to bring about optimal change.

The important take away is that the variable flexibility and adaptability of each system must be fully understood. If the postural system has limitations in range and musculoskeletal adaptability due to muscle, joint or tissue restrictions, and cannot accommodate to changes in the visual perception of space initiated by visual intervention using prism lenses, then there will be a detrimental conflict between both systems. The stress of trying to match to the new visual perception of space will embed the postural dysfunction, strengthening the postural abnormalities much like forcefully pulling against a tight or spastic muscle. The conflict and inability of the postural system to adapt to the new visual orientation to space will cause a dysfunctional rebound and increase the postural dysfunction.

Conversely, if the visual issues are more dominate they will cause compensatory postural adaptations. Attempting to correct postural shifts and alignment without addressing the visual issues simultaneously will put further stress on the visual system. The increased stress of the mismatch can result in further embedding the visual dysfunction.

Effects of Physical Handling on the Postural-Visual Relationship

How does physical handling influence functional vision through facilitating postural changes?

Padula (14) in an unpublished study screened 30 children, ages 2-8 years old, enrolled in an NDT course prior to physical handling treatment sessions, and at the end of the course after approximately 6 weeks of treatment sessions. He found that the "state of visual function and ocular alignment are affected by the state of postural alignment." He noted improvements in refractive state, accommodation, ocular alignment, convergence and pursuits directly related to improvements in the child's postural organization and alignment gained through NDT physical handling.

The following is an example of changes in visual tracking before and after physical handling. Prior to a 1 hour treatment session the child was screened for visual tracking responses. He had difficulty separating eye from head movement, and could not follow the target with any consistency. Following a 1 hour treatment session using physical handling techniques, he was again screened for visual tracking responses. His head-neck alignment had improved allowing for better separation of eyes and head. With this improved alignment his eyes had a more stable base of support to allow dissociation of eyes and head. He was able to track more smoothly in all directions. This is a good example supporting Padula's unpublished study.

Visual tracking before any physical handling was characterized by the inability to separate eye movement from head movement. The eyes frequently lost contact with the target. The shoulders were slightly protracted indicating inefficient mid trunk extension. The neck was slightly back with the chin elevated indicating a lack of good neck elongation and chin tuck. This postural foundation was not efficient for providing a stable base of support for the eyes to easily track without head movement.

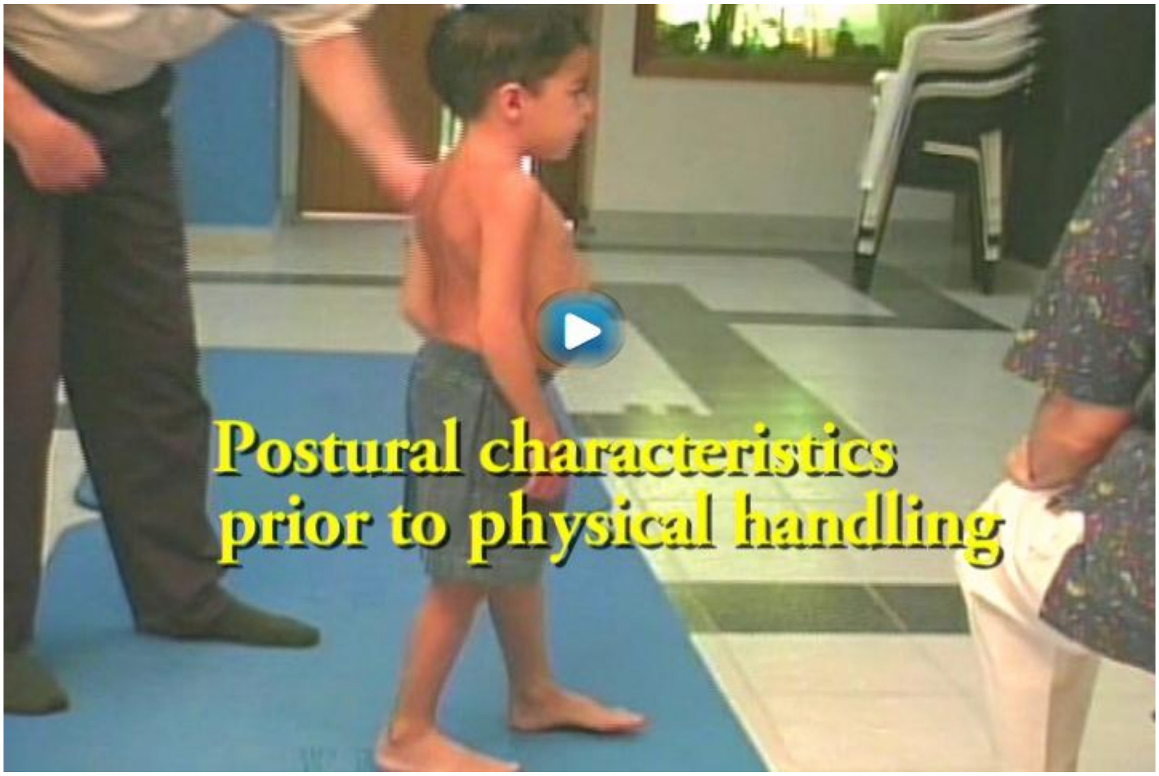
Eye tracking after 1 hour of physical handling showed marked improvement. The eyes more easily followed the target with minimal head movement The eyes maintained contact with the target much more consistently.

Sitting Posture before physical handling **Sitting posture after physical handling**

What postural changes influenced the improvement in visual tracking efficiency? The trunk was more erect indicating a more stable base of support and pelvic alignment. The shoulders were better aligned, indicating more active scapular adduction and mid trunk extension. The neck was elongated with chin tucked providing a more stable head-shoulder base of support for eye movement. These postural and visual changes were achieved with 1 hour of physical handling, without any visual intervention or vision therapy.

Prior to any treatment it is critically important to observe and analyze postural characteristics and how they influence movement organization. Careful observation assists in determining initial areas of intervention and any subsequent changes in alignment and movement efficiency that may result from treatment. Skilled physical handling treatment can be very effective in improving musculoskeletal alignment and therefore more efficient kinesological selection through establishing a more active and adaptive neuropostural base.



This boy presented with various postural characteristics and alignment issues. His abdomen was distended with slight shoulder protraction, elevation and winging of the scapula. He was unable to adapt his pelvis in various positions. with lumbar lordosis and anterior pelvic tilt in standing, and kyphosis with posterior pelvic tilt in sitting. There was more disorganization when shifting to the left.

Areas of initial concern during treatment were mobilizing the pelvis to improve alignment and adaptability in various positions. Establish more normal postural alignment with more active mid trunk extension and scapular adduction. Balance weight bearing on both body sides so that weight shifts could more efficiently be graded. Improve head-shoulder alignment with more neck elongation and chin tuck to allow a more stable base of support for visual motility as well as rotational movement sequences.

After 1 hour of physical handling treatment, postural characteristics and movement organization were again observed and analyzed, and compared to initial observations prior to treatment. It is important to determine what qualitative changes may have taken place so that future treatment sessions can either build on improvements or address additional areas needing more emphasis.

Encouraging changes were observed including more graded weight shift to both body sides, improved mid trunk extension and head-neck-shoulder girdle alignment, improved pelvic adaptation in various positions and improvement in visual tracking.

Physical handling can also influence the effectiveness of vision intervention including the effectiveness of the use of prism lenses. Prism lenses are often used to help organize postural alignment and adaptation, as well as change the perception of space and correct visual midline shift. However, just the use of lenses alone does not always attain optimal results. The type of input and the type of physical handling is important to achieve the most efficient adaptive postural response. different forms of physical input result in different responses. When input simply displaces weight from side to side, the center of mass is displaced outside the base of support. When the center of mass is not aligned with the base of support, postural reactions are at their most disadvantaged in terms of the variety and adaptability of movement and posture. . When input and physical handling is provided down and diagonally into the base of support, postural responses show more active graded trunk control with elongation on the weight bearing side and active lateral flexion on the opposite side. The type and degree of input used in physical handling is critical to facilitating active postural reactions and therefore a more dynamic neuropostural base for efficient motor control.

In this example, in standing, it was demonstrated that simply displacing weight does not activate dynamic trunk reactions or graded postural adjustments. Leaning outside the base of support compromises the ability for functional adaptation.

When input was provided down and diagonally into the base of support, the center of mass remained functionally over the base of support, providing a more dynamic trunk and postural response to graded weight shift.

Again, in sitting, simple displacement of weight without specific postural cues results in the center of mass leaning outside the base of support.

Graded control of weight shift in sitting, facilitated at the hips, provides an active base of support and allows more dynamic postural control.

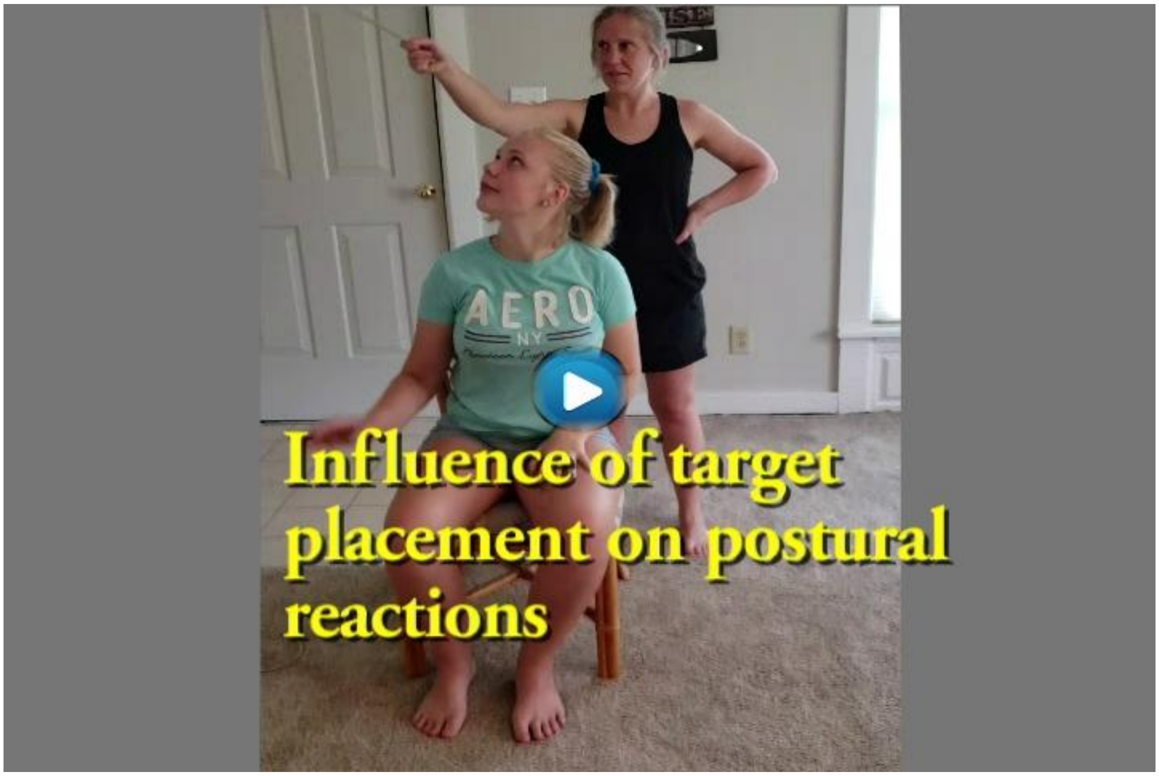
Awareness of the relationship between the center of mass and the base of support is important when asking the child or adult to perform eye-hand or visual-motor tasks. For example, the placement of a target during visual regard with reach, is important in terms of what type of reaction or postural response is desired.

In cases where the individual has a shortening of the trunk due to muscle tightness from TBI, CVA, or neuromotor disorder, preparation using physical handling to elongate the trunk and organize trunk-pelvic girdle alignment should proceed active movement. Additional when there is visual distortion and prism lenses are prescribed to address visual midline shift, the placement of the object of regard will influence the activity of the trunk and postural organization during reaching.

In some cases it may be appropriate to briefly place the target so the client's center of mass leans outside his base of support, as a movement preparation to assist the shortened side to more fully and elongate. However, this should be a brief approach and best performed after physical preparation of musculoskeletal factors. This should be followed immediately with more sustained reaching within the base of support to activate adaptive function laterally as well as rotationally. It is critical to match the visual-postural systems to inter-relate and support each other to attain the most efficient visual-motor functions.

The closer the reach is to midline, the more optimal elongation on the weight bearing side and lateral flexion on the opposite side is achieved. The further away from midline, the more lengthening of the trunk is facilitated without the controlled counterbalance of lateral flexion. The further away and lower the reach from midline the more elongation of the opposite side of the reach is required. The further the center of mass moves outside the base of support, the less functional adaptability is available.

These positions should be used for specific purposes and not as a routine visual eye-hand activity. The most optimal position for the target of regard is closer to midline and this provides the most stable base of support and trunk stability for visual-motor functionality.



In these example we can appreciate the various postural reactions elicited by different target positions. The most efficient reactions occur when the target is closer to midline resulting in a balance between trunk elongation on the weight bearing side and lateral flexion on the opposite side. The further away from midline and closer to the floor, the less adaptability is possible because the trunk must provide compensatory stability rather than more dynamic stability.

What are the considerations for target placement? First the pelvis must be assessed for adaptable range. If the pelvis is not aligned or the musculature is tight or low tone, this must be addressed first. The pelvis needs to be able to dynamically adapt in various planes of movement to provide a dynamic base of support for the trunk. Physical handling techniques to prepare pelvic adaptability should proceed any movement activities.

Next the therapist needs to assess the trunk. Any tightness on one side or another or any passive collapse of one side or another. Inactivity of the musculature causing trunk collapse is a different problem than tightness in the musculature and must be addressed in different ways. When there is tightness preparation techniques to reduce tone and facilitate more active elongation should precede any movement activity. When there is passive collapse, preparation techniques to increase tone and muscle activity must proceed any movement activity. If the musculature is not prepared for the demands of an activity then there is a risk of embedding the problem within the clients dysfunctional range, either by causing more tightness as resistance to the demand or further collapse because of an inability to activate the musculature.

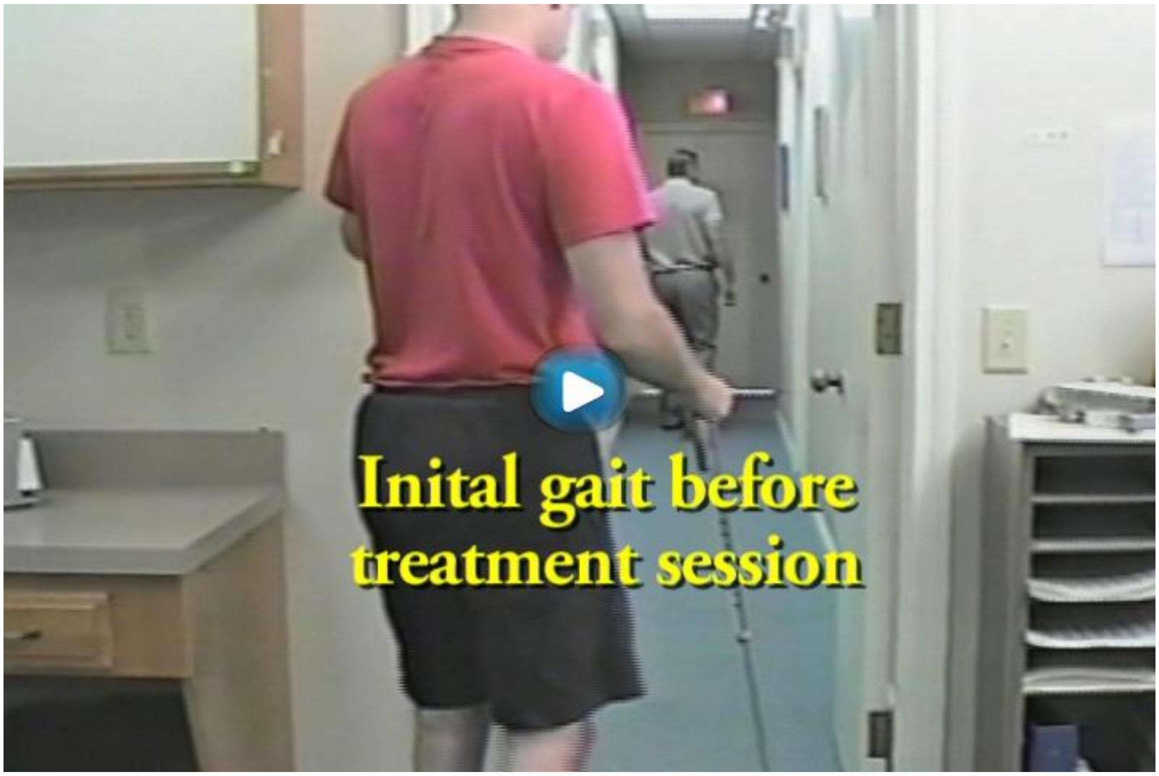
Facilitation and physical handling is not passive. The techniques and handling used provide the client with assisted control so they can activate their own body more efficiently. Passive support does not activate more efficient postural reactions or inhibit compensatory stability interfering with free ranges of movement.

Dynamic postural control results in efficient postural responses. In this next case the difference between passive postural support and dynamic postural support was demonstrated. This child, using prism lenses was required to organize saccades to reach for an object, then release and reengage the object in a different orientation. Simply holding and supporting the child did not result in controlled reach. When physical handling was modified inhibting compensatory shoulder movement and providing input into the base of support, the trunk was more activated and reach became more accurate and controlled. Further, it was demonstrated that different key points of control resulted in different responses, underscoring the importance of the specificity that is required in physical handling to achieve the most optimal result.

In this example this child is unable to control her fluctuating tone during visual regard and reach with passive support.

I this example we can appreciate that more active physical handling allows more efficient reach. Also to be noted is the difference in response based on the key points of control used.

This next case is a good example of how physical handling can improve the functional efficiency and the effectiveness of the use of prism lenses. This young man suffered a closed head injury and as a result he also experienced a visual midline shift and post traumatic vision syndrome.



Observation of his gait prior to any intervention showed a leaning to the left, slight right hip hike, internal rotation of the right leg and toeing-in of the right foot. His stride length was uneven and the right foot lifted and toed-in without active dorsiflexion. His weight was more medial on the right foot. There was little lateral border loading, or active forefoot pronation.

Prism lenses were then introduced and comparison of the clients gait with and without prism lenses was observed. The use of the prism lenses saw minor changes but the fundamental postural and gait issues remained. His weight remained more displaced to the left with left leaning. Hip hike, toeing in with the right foot and internal rotation of the right leg were improved but still present. His stance narrowed and his stride length became slightly more even.

Initial standing alignment showed uneven weight bearing to the left, hyperextension of the right knee, ankle foot immobility, and elevation of the pelvis on the right side with posterior tilt.

Physical handling was introduced to address the internal rotation of the right leg and to mobilize the hip over the leg. Pelvic mobility and adaptation were facilitated through movement of the trunk over the pelvis with rotation.

Physical handling was introduced to address the ankle-foot synergy using mobilization techniques and distributing the weight more laterally on the right foot. A small foam support was used in his right shoe to help activate better ankle foot mobility without hyperextension of the right knee.

With more even weight bearing on the feet in standing, experience in grading weight shifts to the right side and bilaterally was facilitated.

Comparing gait before and after physical handling without prism lenses revealed significant improvement in alignment, graded weight shift bilaterally, reduction of hip-hike and toeing in, and improved alignment of the leg over the foot on the right with a more normal stride length.

We can appreciate the difference with the use of prism lenses without any physical handling and the use of prisms after physical handling. The addition of physical handling, which changed his postural adaptation, improved alignment and achieved better bilaterally weight shifts and stride length, thus allowing a much better and more efficient response than when prism lenses were used without any physical handling intervention.

To appreciate the combined effect of physical handling with the use of prism lenses we can compare his initial gait prior to any intervention, with his responses using prism lenses after physical handling. It is clear that the result of physical handling with the use of prism lenses improved alignment and graded weight shifts. Stride length became more even and hip hike and internal rotation of the right leg and toeing in of the right foot were significantly diminished.

This a good example of the efficacy of combining physical handling treatment with vision intervention. By changing his postural adaptability through physical handling, he was better able to make the adjustments physically to the changes in the perception of space provided through the use of prism lenses. There was more efficient visual-postural matching and therefore more improved function than was seen with the use of prism lenses alone.

Use of prisms alone made slight changes. Use of physical handling alone made more significant changes. Combined use of prism lenses with physical handling made the most optimal changes.

Summary

In each example shown it should be clear that physical handling that prepares for more organized and functionally efficient postural control, has the added benefit of changing the adaptability of visual responses and the effectiveness of the use of prism lenses. Further the type of physical handling required in each cases demonstrates the need to fully understand postural areas of dysfunction. The type of input, direction of input, preparation techniques, key points of control, and the combined use of inhibition and facilitation, must be modified and varied depending on the physical issues to be addressed. Physically handling techniques are unique to any specific client.

Physical handling takes extensive training and experience and is a multifaceted process with layers of techniques, preparation activities, and various degrees and types of physical and sensory input.

Certainly adding movement to vision therapy is important to help match the postural and visual systems. However simplistic weight displacement or stabilizing a body part in no way qualifies as appropriate physical handling. Optometrists are not qualified or trained to provide specific physical handling anymore than therapists are qualified to determine appropriate orthoptic devices.

Further, without careful understanding of the clients musculoskeletal flexibility and adaptive capacities, the use of prisms and/or providing shifts in the center of mass over the base of support can lead to embedding a postural problem and cause dysfunctional compensations. Prism lenses require postural adaptation. If the client is unable to make the necessary postural adjustments due to joint or tissue restrictions, or tightness that has not been addressed, the result can cause more restrictions, compensations, and diminished functional efficiency.

Great care must be taken to physically prepare the client either before or during the use of specialized orthoptics. Optometrists should always consult and work closely with a qualified trained therapist.

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Verification Exam

The following questions are those that will be asked upon clicking on "Take Exam."

1. Without postural intervention in specific areas, visual intervention alone may in some circumstances contribute to more musculoskeletal and postural-functional inefficiencies.

   a. True
   b. False

2. The visual system is highly dependent on the neck which is critical in the organization of sensory processing for motor performance.

   a. True
   b. False

3. Normal alignment and postural adaptation are not essential for optimal success of visual intervention.

   a. True
   b. False

4. Significant dysfunction in one system usually results in compensatory inefficiency in the other system.

   a. True
   b. False

5. Postural analysis is imperative to provide the right influences through positioning and before, or simultaneous, therapeutically intervening with the use of optical devices and vision therapy procedures.

   a. True
   b. False

6. How the eyes relate to space is not dependent on postural alignment.

   a. True
   b. False

7. Deficiency in graded flexion and extension components of movement can cause difficulty in convergence and divergence, as well as an imbalance of the use/overuse of specific visual fields.

a. True
b. False

8. When placing a visual target for eye-hand reach, the further away from midline and closer to the floor, the more adaptability of postural reactions is possible.

a. True
b. False

9. If the musculature is not prepared for the visual demands of the activity then there is a risk of embedding the problem within the clients dysfunctional range.

a. True
b. False

10. Any intervention, whether visual or postural must consider the foundation for function.

a. True
b. False

11. Physical handling that prepares for more organized and functionally efficient postural control, does not have any influence in changing the adaptability of visual responses.

a. True
b. False

12. Physical handling can improve refractive state, accommodation, ocular alignment, convergence and pursuits.

a. True
b. False

13. When the center of mass is not aligned over the base of support, postural reactions are at their most disadvantaged in terms of the variety and adaptability.

a. True
b. False

14. Attempting to correct postural shifts and alignment without addressing the visual issues simultaneously will put further stress on the visual system.

a. True
b. False

15. Alignment does not affect the ambient and focal processes.

    a. True
    b. False