

Therapy strategies
illustrated and
explained in a
manual along with
four 100 minute
to 120 minute DVD's



From 3 years 1 month
to 11 years

Caleb Through The Years

Volumes One Through Four

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Consolidated Into One Text:
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Caleb Through The Years-Volume One

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This movie is a presentation of video and still clips of a child named Caleb.

Records indicate that Caleb has a congenital brain malformation known as colpocephaly and agenesis of the corpus callosum (ACC). In 2011 Caleb's parents found a website at www.nodcc.org that provided them with much more information regarding his diagnosis of ACC. Some of the insights shared on this website follow.

1. "Behavioral Characteristics Related to DCC (disorders of the corpus callosum)

This is an overview of the behavioral characteristics that are often evident in individuals with DCC.

- Delays in attaining developmental milestones (for example, walking, talking, reading). Delays may range from very subtle to highly significant.
- Clumsiness and poor motor coordination, particularly on skills that require coordination of left and right hands and feet (for example, swimming, bike riding, tying shoes, driving).
- Atypical sensitivity to particular sensory cues (for example, food textures, certain types of touch) but often with a high tolerance to pain.
- Difficulties on multidimensional tasks, such as using language in social situations (for example, jokes, metaphors), appropriate motor responses to visual information (for example, stepping on others' toes, handwriting runs off the page), and the use of complex reasoning, creativity and problem solving (for example, coping with math and science requirements in middle school and high school, budgeting).
- Challenges with social interactions due to difficulty imagining potential consequences of behavior, being insensitive to the thoughts and feelings of others, and misunderstanding social cues (for example, being vulnerable to suggestion, gullible, and not recognizing emotions communicated by tone of voice).
- Mental and social processing problems become more apparent with age, with problems particularly evident from junior high school into adulthood.
- Limited insight into their own behavior, social problems, and mental challenges."

2. "DCC are physical diagnoses based solely on an anatomical reality, the absence of the corpus callosum. This does not mean that DCC do not have behavioral characteristics, they clearly do. However, DCC is not a "behavioral" diagnosis such as Attention Deficit Hyperactivity Disorder (ADHD), Non-Verbal Learning Disability, Autism, or Asperger's

impossible. The thing that can happen for this type of individual is that his pediatric therapy can help him minimize the impairments that occur secondary to the compensations used to be functional and independent. Then when the person finds a passion worth his time and effort he can maximize the potential that still exists in his body. Did Mr. Mozgala ever work as hard at therapy as he did at mastering dance? Was his therapy self directed the way his goal to dance and push his body to the limits was self-imposed? Children don't typically push themselves to do things that are difficult. Good pediatric therapists are challenged to help children and families find the balance between pushing for greater skill development and protecting the developing structures.

In listening to Mr. Mozgala, another thing he possesses is an amazing understanding about how his body works, including his limitations. In my opinion the therapists' most important job is to EDUCATE, EDUCATE, EDUCATE. That includes helping the individual understand his body, how to protect his joints and avoid repetitive injuries that could lead to pain that will last a lifetime, and how to perform the needed home exercises that will promote sustained independent control of acquired motor skills.



Returning to Caleb, observe when transitioning from the floor up to standing he uses a pattern of moving onto his hands and feet similar to how he attempted this movement at 3 years. This pattern is encouraged in therapy and home carryover so that he can learn how to get his feet under his body, shift his mass back onto his feet and rise to standing over the stable base of his feet. In this view of him barefoot, it is easy to observe that his feet are not stable on the floor therefore Caleb is unable to move into stance unless someone provides support. His assisted stepping is likewise negatively affected by the decreased range-of-motion present in his heel cords and his lack of stability through his feet onto the floor. Although I was not his therapist at the time, Caleb has received BOTOX to his heel cords two times in the past 18 months. According to the records, no serial casting was performed in conjunction with the BOTOX injections. Observing his assisted stepping it is apparent that he has little or no understanding about his feet being a stable base of support for standing, balancing or stepping control.



"Since the first report on the use of botulinum toxin (BTX) to treat spasticity in children with cerebral palsy was published in 1993, there have been over 100 articles addressing the intervention. The present literature, including several meta-analyses, suggests that BTX provides focal, controlled muscle weakness and, by implication, reduction in spasticity. The paucity of reliable measures of spasticity and the difficulty in measuring meaningful changes in function in children with disabilities makes interpretation difficult."

Pediatrics July 2007 Bjornson K, et al.

"Clear and consistent protocols for optimal management post-BTX-A are not available. Strengthening and gait training in combination with orthoses and night splinting has been cited widely as essential components of care. Serial casting, a sequence of consecutive cast applications and removals, has been used as an adjunct to BTX-A to gain additional range of motion. Tissue elongation is achieved through physiological adaptation to prolonged stretch."

2008 Ped. PT **Kelly et al.**

"Recent studies comparing BTX-A alone, casting alone, and the combination of both reported no significant differences in passive ROM, ankle kinematics, spasticity, and dorsiflexor strength in the BTX-A only group but significant differences in the other two groups."

2005 Dev. Med Child Neurol. **Ackman et al** and
2004 Dev. Med Child Neurol. **Glanzman et al.**

A number of neurologic factors contribute to weakness in these children. Pyramidal tract damage reduces central input to the motor neurons; therefore, the motor neuron pool is less able to drive the agonist muscle. Myelination is incomplete at birth in all children. Maturation of the nervous system occurs as neural circuits are reinforced by repetition, which influences the processes of myelination and apoptosis. The child who is typically developing voluntarily repeats a normal motor activity many times over, but the child with CP may repeat abnormal movement patterns, which in turn reinforce the neural circuits producing them.

...In conclusion, the weakness found in children with CP is attributable to both altered neural mechanisms and muscle tissue changes. ...Because lack of strength is linked to limitations in functional activities such as walking, it would therefore seem logical that therapeutic interventions should address weakness as well as the other impairments that make up the clinical picture of CP to improve these children's levels of activity and participation.

2010 Pediatric Physical Therapy **Mockford et al.**

Recent research has led to widespread agreement that skeletal muscle is significantly altered in individuals with CP and contributes to clinically observed weakness.

2004 Muscle Nerve **Lieber et al.**

Freezing this moment allows the viewer to see how Caleb attempts to align his lower legs onto his feet while keeping his hips lifted. Since he is unable to place his heels on the floor, he remains unstable and unable to move upright. Therefore he

flexes through his legs causing his hips to pull down and placing his mass directly over his toes. From this vantage he knows through experience that he can thrust into extension and the person helping will catch him and support him in staying upright.



Seen on the left, the therapist attempts to keep Caleb's hips lifted and guide him to activate by lifting his hips up and back, then righting his elongated trunk onto his legs.

While being turned Caleb lifts his left leg and holds it up off the floor long enough that the therapist even comments that he needs to put his foot down. He then attempts to stomp it down like he is trying to locate his left foot and its relation to the floor. While attempting to stand we can see that Caleb has no understanding regarding his limits of stability for his standing control. Since his tight heel cords pull him back he keeps his weight forward with his knees flexed and his weight displaced forward onto his toes. When he attempts to stand he loses his balance falling back or forward. In addition we observe how much his hips seem to wobble rather than activate and provide proximal stability.



The basic definition of Limits of Stability (LOS) is the furthest distance in any direction a person can lean away from midline (vertical) without altering the original base-of-support (by stepping, reaching, or falling). Normally adults have 12.5° vertical displacement in standing upright before falling: 8° forward / 4.5° backwards. (Tight heelcords can quickly take the COG outside the BOS.) Factors that affect limits of stability include FEAR, size of BOS and shape of BOS.



Although initially his assisted stepping with one hand held holds the promise of greater control while SMO's and shoes are worn, once he starts to move his lack of orientation over his legs persists and again the left leg seems to get lost while being pulled into a flexion pattern of withdrawal.

In an attempt to maximize Caleb's ankle alignment and promote neutral dorsiflexion, athletic tape is applied on top of his socks to be worn during the therapy session.

Caleb has more available heel cord range of motion that he can functionally use and he needs to have time to practice and learn new patterns of orienting over his feet when the heels are down and the calf muscles are working. The extra support and assist provided by the taping helps maximize alignment even when he fires using the strong thrust and withdrawal patterns he has developed.



The restrictions to his ankle movement are apparent when Caleb is observed moving from sit to stand off his chair. Once upright his alignment in standing with one hand held is greatly improved by his flat foot position. He is even more successful at aligning over his feet during this time of heel's down stance.

Caleb Through The Years-Volume Two

By: Barbara Hypes

To acknowledge the fact that this is the second in a series of instructional materials a brief recap of information from Volume One is presented. In Volume One Caleb began therapy with the writer around 3 years 9 months of age. Volume One highlights his progress up to age 5 years 6 months and a variety of therapy strategies and theories are presented.

In review, records indicate that Caleb has a congenital brain malformation known as colpocephaly and agenesis of the corpus callosum. He began receiving PT soon after birth then OT and speech specialists were added by age twelve months. Despite his unique diagnosis, he appeared to have the same challenges in his motor control seen in children who present with spastic diplegic cerebral palsy. In Volume One it became obvious that Caleb struggles to overcome motor deficits that are more challenging secondary to his poor integration and organization of input received through his sensory receptors. The lack of communication between the right and left sides of his brain were and continue to most likely be the primary reason he presents with such profound processing challenges.

Caleb achieved functional independence in creeping, pulling to stand, cruising along furniture and many activities of daily living during birth to three therapy. At age three he was enrolled in early childhood through the local school district where he qualified for supportive intervention in all therapy services while receiving regular education with age equivalent peers. He could walk short distances with 1-2 hands held or using a walker when this author met him, but his alignment was severely compromised through his legs and trunk. By age 5 years 6 months he progressed to using independent walking with hands held and it was reported that at school he was encouraged to use an adapted reverse walker. In the clinic, walking with less upper extremity support was and continues to be strongly encouraged in order to promote Caleb orienting over his legs and relying on his ankles and leg control for staying upright.

This video provides the viewer with a chronological record of therapeutic interventions and the progress Caleb made in his motor skills from 5 years 7 months through 6 years 1 month.



each step and while the pole is advanced. It is also noted that the degree of internal rotation observed in his feet and legs decreases once his base is more stable. While

Therapy begins with him using poles with greater independence but obvious ankle instability. As stated in the video footage, donning moon sandals improves his walking control while using poles making it easier for Caleb to balance when his whole foot stays flat on the floor during



3. Children who have gravitational insecurity and/or poor awareness of position in space may find it frightening to stand with their shoulders and hips back because they may perceive this as falling backwards. Since they often times are lacking backward protective reactions or stagger stepping they know they cannot protect themselves if they lose their balance backwards. Therefore they err on the side of always keeping their weight forward using hip flexion and thoraco-lumbar extension. These strategies allow them to keep their heads and shoulders up without orienting in the more vulnerable vertical plane.



Standing uphill allows these children to stand up and lean forward into the hill recruiting their knee and hip extensors. Since the angle of the incline helps them feel secure, they can also move into a vertical position with their shoulders and heads oriented back and over their hips. It also promotes active use of ankle plantarflexors in their lengthened ranges. Here the therapist keeps her body close to Caleb until he feels he can safely move more upright without falling. Providing this type of exoskeleton allows the child to find the limits of his control without misjudging the limits of his safety.

4. Keeping his toes elevated on the end of the ramp while wearing the moon sandals Caleb is asked to bend down to promote elongation to his hamstrings. The ongoing challenge of maintaining functional range through the leg muscles as children grow is a daunting prospect in therapy

as well as home carryover. It can also become an uncomfortable burden for the child if range is always obtained through passive stretching



activities. As is true for most of us, when the stretching occurs during play a more significant and meaningful lengthening can be obtained and sustained.

5. Note that the therapist provides assist to keep the heels seated in his orthotics and she promotes knee extension while he bends forward to create elongation to his heel cords. Many children will move down by collapsing over their ankles and bending at their knees. This type of squat when performed while standing uphill on a ramp will typically cause the individuals to lose their balance and fall or roll down the incline. But, it will prevent the individuals from stretching their heel cords and hamstrings and if they are tight the children may prefer falling to stretching. Keeping the hips forward and lifted creates the need for the bend to occur at the hip joints thus



As he explores his control Caleb even discovers how free he is to reach the floor and return to stepping. Experiencing the control to safely move down makes staying upright in standing feel less daunting.

Seen here a month later accompanied by his dad, Caleb is able to walk given one hand held assist while the therapist promotes a greater step length and heel strike with each step.

Although Caleb lacks the single limb stance stability to control his swing and heel strike, at almost 6 years he continues to possess adequate range of motion in the heel cords to allow toes up with heel strike when the needed support is provided.

After several repetitions of this stepping Caleb appears to become more aware of the required control he must use and in response he grabs for extra support and collapses through his legs. Instead of requesting that the child push or stop falling, the therapist and parent immediately help him back to stance and he is instructed to stay up and remain safe from harm. Since he may be getting overwhelmed with the control he is required to generate to step, focusing on how he needs to "stay safe" can prevent him from refusing to stand and further shutting down his wavering motor pattern.

To begin this session Caleb is moved into a standing position and shown a new toy that shoots and sticks to the window. While focusing on the fun activity he demonstrates his ability to independently stand even when no moon sandals are donned. He then uses this same independent standing control while setting the intensity on the e-stim units. But in the conversation the therapist states that yesterday Caleb was unable to perform the previously observed stepping and it should be noted that if he's asked to stand independent he very likely would demonstrate greater instability and failure. His control is inconsistent and variable in ways that are not attributable to his motor system alone.



occur in intense spurts followed by home carryover and close monitoring of specific patterns or signs that may indicate a need for another burst of direct intervention. Therefore as much as possible, families must stay very involved in promoting coordination along with avoiding duplication of services between home carryover, school and outpatient clinic services, in order to insure appropriate ongoing intervention in both an educational setting and a medically focused approach. This overview is of the therapy Caleb received in a medically based therapy program. The emphasis on helping him gain greater variety of motor skills helped Caleb develop ideal alignment and functional control without creating compensatory patterns that would lead to contractures and deformities especially with growth. Volume three begins the next month when Caleb is 6 years 2 months old.



Clinic therapy emphasizes further development of the components of control for gait with the hopes that Caleb will use fewer compensatory patterns as he eventually becomes less dependent on equipment for walking. During this session he is able to take several independent steps wearing moon sandals when only verbal cues and casual stand by assist is provided. Watching the

video clips it is very obvious that Caleb feels more confident taking these steps. In the past when he has attempted individual steps followed by a pause to catch his balance he has not been able to consistently stay upright between steps while linking more than 2 in a chain.

Even when he is asked to turn Caleb demonstrates a sense of understanding about how to negotiate his feet and legs on the floor and in relation to his hips, trunk, shoulders and head in order to face the opposite direction. This turn takes time but now that he is knowing and owning the understanding about how to make his body do what he wants, giving him time to perform the tasks independently is a better use of precious therapy minutes than turning him in order to begin a task. In the past the therapist at times would help Caleb return to standing or orient his body in the appropriate direction by doing all or most of the work. Now it is obvious that Caleb can do the work by himself and is motivated to use this emerging understanding and control. Although deciding when to provide greater help still needs to be task specific, in general more time is now spent allowing the individual to learn about his body through trial and error.



In addition to demonstrating greater control for stepping and balancing between steps Caleb also shows improved grading when he does feel the need to reach to the floor. He and I no longer refer to this as "falling". Instead it is now referred to as "checking in." By using this terminology the therapist is helping Caleb and his caregivers understand that at times he may



structured therapy setting.

need to use his graded control to touch the ground simply to be reassured about his ongoing orientation and balance. Recognizing this move as a check helps everyone understand that with greater confidence and more opportunity to practice Caleb will need fewer of these casual touches. Along with the increased limits of stability provided by the moon sandals Caleb continues to demonstrate improving control in all of his motor skills higher against gravity. This level of control is not as consistent when the moon sandals are removed or when he is in a less controlled environment outside of the

During the next session his other therapist sees him and she begins by having Caleb stretch his hamstrings and heel cords by sitting in the cube chair wearing knee immobilizers with the Nada® chair secured around his pelvis and feet. While swinging she provides a deep compression into his feet that reverberates through his joints as a way of stimulating his proprioception and kinesthesia over the increased range. The swinging simultaneously provides visual and vestibular stimulation to drive other brain areas to help Caleb develop all three redundant systems used for orientating in space, these being somato-sensory, visual and vestibular.



As previously cited, according to Scrutton, “*spasticity is but one feature of the upper motor neuron syndrome. Although clinicians tend to concentrate on its positive features (spasticity, clonus, hyperreflexia, co-contraction), it is the negative features (weakness, loss of selective motor control, sensory impairment, boney and alignment changes) that ultimately may limit function and determine prognosis.*” For these reasons, the emphasis in clinic therapy is concentrated on gaining strength, always alignment, motor control, and improved sensory integration in order to support Caleb’s motor development evolve.

Discussing evolution of a sensory diet Heller notes: “*Hard work, with heavy doses of deep-pressure touch and movement, was adaptive for survival, keeping bodies and minds in good working order. At the end of the day, it brought tranquility and sleep. Movement is medication. It modulates our nervous system, creating energy, stamina, and relaxation; it improves our self-image and makes us stronger mentally and physically.*” Maybe this is why, despite his physical challenges, Caleb seems to be using his motor control as a foundation for his efforts at learning. When he is given permission and assist to pair movement with challenging learning concepts he is able to attend longer and recover more readily from a confused or shut down period.

Both of Caleb’s clinic therapists believe that stretching activities need to occur during dynamic activities so that the newly achieved available range can simultaneously be activated. When range is gained without activation the new freedom may be frightening and confusing for the

bearing during therapy. In the movie clips his decreased comfort in his own body is apparent. He is more easily off task and seems more demanding and "bossy". This is a typical sign exhibited by Caleb when his level of chaos and disorganization elevates.

Even though he only received serial casting, the ROM Caleb gained caused sufficient stress to interfere with his willingness to stand. In addition he initially would not walk with hand held or walk independently with his poles for several weeks once the casts were removed. It is speculated that had he lost his sensation his response might have been even more exaggerated. Perhaps it could also be argued that adding BOTOX to decrease the sensory

input to the elongated muscles may have caused him to ignore new sensation and mobility but this was not tested and had previously not been the outcome following BOTOX injections.



to be stable in stance on the other side.

After working to build his acceptance of stepping the therapist moves away from providing the support and Caleb's fear of this activity makes it almost impossible for his dad to promote a normal step length. When the therapist pulls on the leash as shown on the right, Caleb responds by flexing through his trunk and hips. The knee immobilizers make him incapable of flexing through his knees but his reverting to withdrawal is a pattern previously observed when Caleb feels unstable and stressed.



As noted by Heller "*This folding is a primitive startle or "red light" reflex wired into our system to help evade a threat. Originating in the lower-level brain stem, a cascade of neural impulses unfolds from head to toes: eyes narrow, jaw and face tense, head juts forward, shoulders lift, elbows flex, abdominal muscles contract, crotch muscles tighten, knees bend and point inward, ankles roll in, toes lift upward. (Hanna) When sensory defensiveness has been present for years, muscles never get a chance to relax, and the body freezes in this primitive survival stance.*" In the case seen here it is apparent that the trigger leading to this response is very easy to activate and Caleb is finding it difficult to move out of his immobile, somewhat frozen state.



While the dad and therapist discuss some of the impressions from the results of the serial casting Caleb is left to step independently to the family car with the aide staying nearby and continuing to film. Even knowing he can walk to the car and be finished with therapy is not enough to motivate him to use his poles to step independently. He makes only a few steps that are very small and labored during several



minutes of filming. It is apparent he feels unstable on his legs and he lacks the confidence to rely on this distal control for moving.



Since it is obvious that Caleb is not going to walk, the knee immobilizers are removed. His reluctance or apparent inability to step persists. The one reason he is willing to stay upright could be because the alternative is to move onto pavement in the middle of a parking lot while wearing shorts. Fortunately he does not call out for assistance or become overly alarmed about being left to walk independently to the car. But, he also fails to recruit the control to actually move.

After waiting for an extended period the therapist moves in to assist Caleb walking using his poles. This leads to some stepping but it is still apparent that he is very stressed and the walking pattern used is poorly aligned as well as collapsed. Even with maximum assist Caleb is truly unable or unwilling to step the first few weeks after the casts are removed even though the only intervention he received was serial casting.



Finally Dad holds one hand while the therapist provides support to the other side and Caleb walks to the van. Using short steps along with a great deal of pulling through his arms as a way to un-weight his legs allows the threesome to move to the family van so that therapy can end.

his arms out to the sides and shift onto one leg in a manner that feels like what he experienced during side-to-side swinging. The goal is to help Caleb connect the experience of effortless weight shifting while his trunk stays dynamically lifted over his stable legs. When he is able to keep his trunk filled with air and lifted (like a hot air balloon), he can float his trunk to each side causing the opposite side leg to be un-weighted and free for stepping.

In the first image it is apparent that Caleb is able to free one leg for stepping using a compensatory flexion/adduction pattern in his arms that locks his upper body into a facade of stability.

Given a minimal cue through his humerus Caleb is able to trust “floating” his trunk laterally freeing his left leg for stepping by using dynamic three-dimensional lifting in his hips and core. His emerging control allows the family, Caleb and his therapists to see that greater integration of his sensory-motor control is possible with ongoing work alongside a specialists that can determine what missing components Caleb still needs to master and integrate.

Seen next at 7 years 8 months, single limb stance shown on the right and left is an ongoing challenge for Caleb for many different reasons. One of his major difficulties stems from his inability to sustain pushing through one leg while moving the other leg into abduction away from the stance side. To assist with the required dissociation and inhibit his lower extremity adduction pattern, Caleb is positioned with his legs straddled over a 4" wide balance beam. The sidewalls of the fixed structure provides an external cue to help Caleb feel when his legs are shoulders width apart and this reminds him to keep his hips abducted which promotes a more dynamic wide base of support for improved lifting through his trunk.



As noted in these pictures of single limb stance to each side, a second challenge to the activity is the control needed to shift laterally onto one leg. In each of these initial images note the trunk lean used to create the shift. Rather than shifting in his hip joints to bring the pelvis and trunk onto one leg as a combined unit, Caleb leans his trunk over in order to keep his pelvis from dropping down once he begins to lift his opposite side leg. In the first image of his shifting to the right we can see how Caleb is able to lift his left leg while keeping his pelvis slightly elevated on the left side. In contrast, he actually appears to be weaker for standing and loading on his left side during this task and as he

attempts to lift his right leg the pelvis on that side drops making it impossible to lift his leg adequately to place it on the surface.

A third challenge is keeping his pelvis level and aligned on all three planes when his legs are maintained in the dissociated position. While standing on both the right and left sides he appears to have the ability to keep his standing side hip abduction dynamic enough to keep the pelvis aligned at least for some of the time spent in the position. On the video it is more apparent that his control between the right and left sides differs making it difficult for him to maintain this overall alignment.



Observing him while standing on his more dominant right side note how the left leg tries to collapse (adduct) toward the right stance leg. This affects his head and eye position, shoulder control, trunk lateral flexion and overall forward orientation. In contrast, once he corrects his hip alignment



he is in a better position to attempt to catch the balls his caregiver is throwing.



Transitioning to another skill, although we have observed Caleb working on jumping in a variety of ways in Volume III, in this series of pictures he is given two hands held assist during the activity and he is able to take advantage of really pulling through his arms to control and create his jump. This type of pulling creates an entirely different control than what he needs to develop for jumping, but providing him with the experience of un-weighting his feet followed by landing, as well as flying through the air gives him opportunities to rely on his senses for orientating in space and staying righted as well as recovering his upright alignment.



During this jumping activity Caleb moves from the 4" balance beam over a gap and is directed to land on the padded rectangular target. Note how high he gets in the first image. Once again, this is secondary to the strong pulling he does through his arms as well as the lifting supplied by the adults. In the landing image his arm pulling is very obvious because since he has to jump in front of his caregiver pulling through the

arms does not provide sufficient propulsion to get his body loaded onto his legs. Instead his legs are pulled too far forward and he is dependent on the assist being given to prevent a fall. This jumping activity is encouraged as a way to give him the freedom to experience propulsion toward a target and to promote his learning how to trust his legs as a base of support that he needs to keep his body righted over in order to have balance against gravity.



As noted in the last month, the type of facilitation being provided during his independent stepping occurs very distal through his shoulders or arms. Caleb and his therapist have learned to "dance" in this assisted stepping manner. By providing him with a minimal tactile cue at his shoulder on the stance leg she reminds him to load that hip while moving his pelvis forward on the same side. The fact that the contact assist can occur at his shoulders and create an effect through his pelvis indicates Caleb is sustaining co-active work in his core. That is why in some of the images his body stays directly oriented over his legs and his trunk appears well aligned rather than tilted or collapsed. With the minimal cue at the shoulder the therapist also non-verbally communicates that she will assist him in grading his shift to the stance side both

slightly laterally as well as forward. This allows him to move his pelvis and trunk as a unit over his standing leg. It should also be noted that because she is behind him he responds by safely staying more erect without being concerned with falling back. Both of the images shown depict the contact being provided on the stance side. Once his swing leg lifts and begins to move past midline the assist moves away from the lateral/forward shift on that side and will transition to the other shoulder with foot strike and loading. Note in the second picture above how Caleb is allowing his pelvis to be a dynamic part of his stepping. The second image shows how the pelvis is dynamically held up and back on his swing side and this occurs due to the active firing of hip lateral muscles on the stance side. Even though there is some lateral flexion in his stance side trunk, the image allows the viewer to see how Caleb is using his left arm to keep his trunk more aligned over the stance leg rather than allowing his trunk to collapse at the



Although facilitated stepping on the treadmill is not a new or different technique, the set up continues to change. In the first image note how Caleb is allowed to hold a support that is over his head and fairly unstable. The facilitated steps challenge him to move into full hip extension on the stance side thus creating the need for greater step length since the platform continues to move.

Once he begins to actively use his hip rotation and step without assist the therapist

encourages him to keep holding the handles while she facilitates and influences the needed subtle weight shifts and rotation at his pelvic-femoral junctions.



As soon as he feels stable he is instructed to let go of the handles and walk while the therapist continues to provide the subtle assist at his hips. Even though the therapist maintains contact with his body during this stepping, Caleb is using the motor patterns he needs to master. Caregivers who are interested in maximizing repetition of desired motor patterns may be able to learn how to assist their child's walking in this type of situation at home on a treadmill. Since the surface moves the skill of stepping can be repeated while the person assisting and the child stay in one location.

Although this appears to be very easy, the type of facilitated stepping seen in these pictures is much more difficult for the facilitator to master. The adult is attempting to have an impact on the hip joints while only touching the shoulders. In the first picture the length of the step along with the overall trunk alignment indicates that the facilitator has been successful. In the second image it is apparent that the trunk is staying lifted rather than collapsing forward, but there is some concern that the core abdominal control is faltering and greater use of thoraco-lumbar mobility is occurring. In



the last picture the walking task is much more challenging due to the increased weights the child is carrying. This subtle change in the weight at the distal ends of the arms has caused Caleb to revert to using his less mature side-to-side trunk sway pattern even though the therapist is trying to influence the motor control he triggers. Walking control is a huge challenge for Caleb. Walking while carrying objects like a backpack, or a lunch tray or his laundry, creates entirely different demands on the control needed. When the individual has limited control to start, any added challenge can cause the apparent skill to fail or once again fall apart.

Five months later, at 8 years 2 months Caleb is more confident in his independent stepping control and he can consistently move given no assist while staying on his feet in the structured environment of the clinic. He still has good and bad days where his stepping control is more or less organized but in general he is consistently “owning” his ability to use his legs for balancing and stepping as a primary means of mobility.

During this session Caleb challenges his grandmother to a basketball shooting game and the game requires the opponent to move to the same spot where the other person made a basket. This motivates him to move around the small perimeter of our shooting area and it is thrilling to see that he uses sideways stepping and backward steps to efficiently move from spot to spot. In addition, he does not become too distracted away from the game of shooting while he is concentrating on getting his body to the correct spot in the room. He is developing greater ability to multi-task walking with attending to other experiences in his surroundings. Walking is becoming more organized so that his cognition is not fully occupied by holding his body parts together in order to move.



Caleb next exhibits his internally driven and organized plan for moving sideways. His control in stepping is finally moving into a more integrated stage where he is able to use the components he can consistently perform and execute new skills.

On the left he is seen moving backwards with very small steps. In these pictures we can observe how he throws his arms to one side in order to free the leg on the opposite side and scoot it back. Although this is a very immature pattern, he has a strategy for moving his legs backwards while staying up. Also note that in all of these images Caleb is actually wearing sandals with no orthotics or graphite inserts and he is still able to step with his feet staying flat on the surface.





At this point, walking forward and bending down to retrieve the ball from the floor is the easier more familiar part of the experience. The fact that his control is improving and he is beginning to experiment with figuring out how to combine his movements in ways that allow him to do different tasks means the component parts for independent stepping are getting more integrated and organized.

It is worth noting that this is the narrating therapists first time to see Caleb in 3 months due to a leave from work. The fact that he continued to progress his motor control while being seen by other therapists is important because the strategies being applied are not so complex that only this therapist can perform

them and help Caleb evolve. All therapists can approach their patients with a renewed focus on treating each of the systems that may be interfering with their motor skill development. Although no video footage of his treatments is available, the therapists' that worked with Caleb focused on helping him integrate his somato-sensory, visual and vestibular systems so that they would provide a useful foundation for helping him stay upright against gravity, have balance and move with control. While staying focused on this emphasis they continued to promote strengthening, alignment, range of motion, co-activation of synergistic motor patterns and motor planning. Another note is that Caleb is now seen one time weekly in the clinic and he receives aquatic therapy in the community. The goal to help Caleb function in his community using good motor control is being further supported by getting him involved in peer appropriate social activities such as swimming. In addition, home carryover of walking in a more supportive buoyant environment allows Caleb to practice his emerging independent skill while receiving intense input to multiple sensory receptors when walking is practiced in the pool.



In my absence, the clinic installed a zip line so of course Caleb had to check it out during our first therapy session. With no real stabilizers to hold, Caleb is given maximum assist to help him climb onto the tall bench and stand. After turning around he is given the handles and encouraged to slide down the zip line to the crash mats at the other end of the gymnasium.

This activity challenges the rider to fire sufficient control to support holding the weight of his body using his arms. Getting the child to repeat the fun task over and over can promote strengthening to the core and extremities. The movement can be fast or slow and assist can be minimal or maximal stimulating the sensory receptors about acceleration/deceleration, direction of movement and speed. This activity is a good one to alert the body and turn on the motor system for holding itself together. It does not require the professional skills of a therapist

once the child and assisting adults understand the limits of their control. When possible, parents can set up enriching sensory-motor environments for a child like Caleb in order to stimulate his sensory receptors in order to support his motor skills.

Returning to the previously seen neuro-typical child, this picture of her climbing reminds therapists how climbing promotes range of motion in the leg muscles, strengthening to the core muscles and extremities, dissociation between the right and left sides, movement of the head in different planes and orientations, joint mobility (especially in the hips) and loading (vaulting) as well as stabilizing through the arms and legs. Climbing activities can promote a multitude of control that Caleb needs and establishing climbing opportunities at home or in the community can lead to excellent home carryover directly related to therapy goals.



At the end of the session Caleb demonstrates less collapse in his trunk during one-hand held assisted stepping. The therapist can provide much less resistance through her arm because Caleb now relies less on the support since he is controlling more of his weight shifting, loading and balancing. Given no orthotics or inserts Caleb consistently steps with his feet fairly flat and his body somewhat well aligned over his legs and feet. In the video a clonus is present and can be observed at times during loading. This reminds everyone that although Caleb can function in bare feet, he is still at risk of returning to a pattern of toe walking secondary to persistent weakness and dis-coordination in his calf muscles. His ankles and feet provide an inconsistent and unreliable base of support for his balance and equilibrium during upright anti-gravity



activities. Therefore he is at risk of returning to using motor patterns previously observed, especially as he grows and demands on his distal control increase.



At 8 years 3 months Caleb is able to walk across the room with his grandmother providing a dynamic contact guard assist through his shoulders and upper back. It is also significant that in these two images of this session Caleb is walking while wearing his MBT shoes. Since these displace his base of support and tend to exaggerate his attempts to move forward onto his toes, walking in these shoes is a much bigger challenge. Giving him opportunities to walk in these rounded sole shoes provides Caleb with the experience of having a freer forefoot and exposes him to the possibility of push off. But, walking alongside does not cause him to use this potential control. Promoting the components available in the appropriate timing with each step would more realistically be facilitated with him walking on a treadmill. Assisted stepping on a moving surface would allow for greater repetition of emerging components. Video footage of treadmill stepping was not recorded.

The other clip shown during this session where he is wearing the MBT shoes, once again highlights how easy it is for Caleb to be off task and overwhelmed by the chaos of controlling and moving his body while being in stimulating surroundings. When asked to step Caleb appears to be non-compliant and some adults feel he is not being a cooperative participant in learning when he hesitates or gets off task in this manner. This reminds us again that interventionists must recognize the severity of his processing deficits secondary to his neurological malformation. One of the helpful things in working with Caleb is that the adult needs to know when to push and when to back off and actually provide greater support. All interventionists can become frustrated when Caleb doesn't appear to comply, but the adults working with him need to be responsible for providing a different approach instead of expecting Caleb to somehow handle the stress that is occurring yet again in his brain. By taking this approach Caleb continues to make consistent gains in therapy. Non-compliance with therapy was never a significant issue during our sessions.



Caleb's poor trunk alignment persists and is a major concern to his family. In addition to working on core strengthening activities during therapy, this therapist believes that one of the reasons Caleb relies on his thoraco-lumbar extension and hip flexion for stability is because this allows him to collapse his boney structures together. When body is collapsed on body this provides ongoing input through the joint receptors regarding alignment of the structures. Although Caleb can hold his alignment anti-gravity, he does not typically sustain this lift when no supervision or assist is provided. This may indicate that it still feels too risky for him to sustain his dynamic 3-dimensional lift against gravity because he receives little or no input about where he is when his body is lifted rather than stacked. Therefore it won't matter how strong he is proximally if he can't use the control because of lack of integrated



feedback regarding his position. Strengthening is important but increased awareness of how to use his strengthened core is imperative if he is going to successfully give up his stacking patterns and use more mature dynamic holding control.

Another important consideration regarding Caleb and his overall development, control and fitness is that according to Fowler et al (2007)... "Inadequate physical fitness is a major problem affecting the function and health of children with CP. Lack of optimal physical activity may contribute to the development of secondary conditions associated with CP such as chronic pain, fatigue and osteoporosis."

Children with CP are weaker, have less endurance and exhibit reduced physical activity levels compared to peers without CP.

Impairments such as weakness, muscle spasticity, and deficient balance make it difficult for children with CP to participate in sport and play at a level of intensity sufficient to develop and maintain normal physical fitness levels." Despite his different diagnosis, Caleb is at risk of all of these outcomes secondary to the level of motor impairment he exhibits.

With a focus on core strengthening and stimulation of sensory receptors a variety of exercises are facilitated while Caleb moves and is moved on the tall ball. This enriched vestibular,

proprioceptive and kinesthetic experience taxes his core while driving his need to find his equilibrium and maintain his balance on the mobile surface.

Work begins in prone with Caleb (8 years 4 months) holding the suspended trapeze. He is instructed to move his arms away from his body and the therapist simultaneously shifts his trunk in the same direction creating a larger gap between his arms and the point of contact his body has atop the ball. Each incremental shift further into space exponentially increases the demands on the proximal core control. In this image the therapist is seen to provide a lift to Caleb's trunk

between his ribcage and pelvis. This is the point where he typically collapses, so facilitating active assisted lifting promotes sustained holding of this region leading to gains in strength. One may also note the shoulder elevation being used as the arms move further away from his body. The therapist is previously occupied with a more critical alignment issue so she is not able to inhibit this shoulder elevation. If the focus moved to the shoulder alignment greater humeral horizontal abduction or shoulder girdle expansion could be provided. This would elongate him into space due to the side-to-side opening in his upper body and it would cause the head to dissociate from his elevated shoulders creating the need for Caleb to activate more dynamic neck muscle firing to hold the weight of his head in space. When the shoulders are expanded, the child may feel like his head is "dumped" into space because he no longer has a collapsed saddle where his head can passively rest. Even though his shoulder elevation indicates he is compensating to keep his trunk lifted, the therapist chooses to promote this degree of excursion into space through her forward movement of the



ball because her emphasis is on trying to promote core work and connection of his upper body to his lower body while his mid-trunk remains well aligned and active.

He quickly fatigues so the position is changed to supine. After initially allowing his upper back and head to rest against the ball, Caleb is instructed to pull on the trapeze and lift his body. Here again the reader can see that when Caleb pulls his body up at the same time that the therapist keeps his legs lifted and pulls the ball slightly away from the trapeze, space is created between the upper and lower body and the person lifting must activate his core musculature to hold his body together.



Combining the two tasks Caleb is told to lift his body using the trapeze while his legs are moved through side lying in a log rolling motion. He is encouraged to keep his body lifted throughout the transition as he moves from supine to prone and back to supine so that oblique core musculature is activated and strengthened.

Prior to moving

away from the ball the therapist transitions Caleb from sitting to standing on each side in an effort to promote single limb stance on one leg while keeping the other leg supported on the tall ball. This challenges his ability to load into his leg as well as his available pelvic-femoral hip mobility. The activity also inhibits him from collapsing at his thoraco-lumbar junction because of the effect the lower extremity dissociation creates in the pelvis and lumbar spine. As seen in the first two pictures, weight bearing on the left leg is very limited and overall alignment is severely compromised. In the images of weight bearing to the right side alignment is significantly improved through his trunk, but the weight-bearing hip stays in flexion perhaps secondary to mobility limitations at the pelvic-femoral junction. Is this occurring due to joint limitations, boney alignment, orientation and development of the long femoral bones given the abnormal pull throughout his developmental years, weakness or a combination of all of these issues? Or, is Caleb apprehensive about moving onto one leg when he is moved in this manner? Therapists must determine the possible causes and assess what can be worked on directly in therapy and what can be gained and maintained through consistent carryover of specific activities by caregivers.





Moving into a plank position while weight bearing on the *BOSU®* proves to be another extremely challenging activity. Initially it is apparent that Caleb has no

plan for how to get his body to align into a horizontal position so the therapist tries to help by lifting him at his pelvis while tipping him forward causing him to load his arms onto the mobile support. After he begins to recruit some active control she is able to move her support toward his thighs while Caleb keeps his upper and lower body aligned and lifted using active holding in his core. Note how the therapist can manipulate the shoulders into greater humeral flexion after she dumps his weight into his arms by elongating his trunk away from his stable shoulders. Holding the plank position while keeping the arms in humeral flexion above 90° places more demands on the trunk control.



After a short period Caleb collapses under the pressure of working to hold the weight of his body lifted. Following his collapse the therapist tries to help him move back into the plank position but Caleb is not able to re-activate his hip extension. Instead he hyper-extends through his trunk or flexes through his hips. Strengthening strategies to promote

greater holding in the core while being able to load and shift over weight bearing extremities needs more work and this type of assisted push up activity can be performed at home as long as the person providing the assist understands the goals being pursued. It is not helpful for Caleb to perform "x" number of push-ups regardless of his alignment. Instead, he needs to hold the well aligned plank position for longer and longer intervals, be able to assume the position with less assist and perform more repetitions of the closed packed isometric holding.



Remember, earlier a prone plank position was being performed in home carryover while Caleb stayed in a vertical prone alignment. He is demonstrating gains in his strength when he is able to begin working on this difficult skill in horizontal prone. At the end of working on the BOSU he is able to push up and stay lifted for several seconds when all assist is removed.



holding the weight of his leg, then places the foot into an appropriate step position. This is repeated to each side giving the child the potential to feel how to functionally use dynamic holding in his core and one leg standing control during the functional skill of stepping. Connecting the work performed in therapy to the skills the child is interested in mastering leads to greater understanding about why performing the hard exercises can lead to success in learning desired control.

In this sequence of pictures of stance on the left leg we observe that the leg is initially held in a position where the hip is extended and the knee is bent. This is the same position that was promoted when he worked on kicking and it is important control to master because it requires the individual to combine flexion and extension strategies through the lower extremity. Being able to pick up his foot in this manner allows a parent to brush the dirt or snow off his shoes before he moves into the house, or allows someone to dry his foot before he steps out of the tub etc.



Returning the focus to the pelvis, note that it stays back on the right side and appears unstable on the left because the left hip is adducted allowing the pelvis to drop into the left leg. Despite the hip flexion, when the right leg

advances for the step the pelvis initially moves forward on the right then some rotation occurs in the hip joints so that the advancing leg moves ahead of the stance foot and even in front of the child's head while the pelvis moves slightly back. This pelvic-femoral rotation is a critical component in typical gait. Caleb is not pushing his stance leg sufficiently to move into hip extension and it appears the body is being pulled into flexion through his extremities. Even though he has overhead support to encourage him to stay lifted, when he walks along this cable he appears to be unstable and unsure about loading and transferring his weight over his feet.



Once stepping is allowed without holding for 3 seconds the speed increases and the therapist needs to cue him medially on his lower legs to get Caleb to keep his hips broader and widen his base of support. He continues to step while staying in too much hip flexion and he begins to lean his upper body forward instead of keeping his head, shoulders and pelvis aligned on his feet but at the same time, he exhibits greater comfort with this facilitated stepping.



Next, all assist is removed, and stepping while holding an overhead support becomes much more difficult. Since the trapeze is attached at a single point, it is free to twirl and when the therapist lets go it's easy to see that Caleb's entire body begins to twirl around the stance leg in a manner that appears and probably feels out of control. In the third picture above, Caleb is able to pull his right leg back toward the right side in order to recover some control of his alignment, but he is still adducted across midline and will have a scissoring gait pattern if he can't figure out how to dynamically hold the alignment of these rotational forces that are part of controlled walking. Having the opportunity to walk along this cable has exposed the severity of impairment in his dynamic core stability for holding him aligned in space. Comparing the control observed during active assisted stepping versus the above steps it seems apparent that strength may be an issue, but a bigger challenge is his impaired ability to fire available control appropriately during the motor task. Caleb needs support and work to promote

accurate timing, sequencing, intensity, plan, direction, duration, and tone of his motor skills. He also benefits from support and attention to strengthening, stretching, aligning and promoting joint mobility needed for desired control. At 8 years of age he is also busy with schoolwork and peer activities so keeping a balance between all of the demands in his life becomes progressively more difficult. Choices regarding how time will be structured may mean therapy or home carryover activities are no longer a primary focus.

Maximum function with minimal pathology does not mean a child stays in therapy until absolute quality motor control is mastered. Children can move in and out of intense therapy emphasis depending on the goals and exhibited control they possess at any particular time. Therapists educate families and patients about components of control that are most vulnerable when therapy is decreased. Knowing that therapy needs to increase for a period of time if growth has led to loss of function or tone is interfering with motor control or the child is complaining of discomfort arms the family with child specific signs to monitor to know when therapy is needed to prevent more extensive deterioration. Everyone can benefit from therapy. The challenge is to know when the individual really NEEDS therapy in order to master a realistic level of functional independent control.



One week later
Caleb is able to
perform the
plank activity
while activating
better dynamic
holding in his
core and
sustaining the
work across his

pelvis and legs for longer intervals. It helps exponentially when the aide provides some assist to stabilize the BOSU and the activity is no longer new, but the degree of improvement is significant. Perhaps this indicates some home carryover has promoted greater awareness of his alignment or improved strengthening. Or, maybe this is just a very organized day for Caleb. The fact is we don't always know what makes the difference in the observed control from session to session.

Throwing while maintaining 1/2 kneeling is more successful today than it was at the last session but the therapist must still provide a great deal of assist to his legs and hips in order for Caleb to maintain his dissociated position during the functional task. Because it requires so much assist 1/2 kneeling work is most likely not a recommended home carryover position. In therapy the appropriate alignment can be promoted to allow work for strengthening to the hips, legs and trunk.



As shown in the 1/2 kneeling pictures, Caleb has difficulty keeping his hips in extension, holding his flexed hip in good alignment, keeping his pelvis level and lifting his trunk dynamically off the dissociated base. Given dissimilar support each time the activity is practiced promotes and challenges activation of different components.

Moving up to standing while continuing the throwing game challenges Caleb to use trunk, hip, knee and ankle balance strategies to stay in equilibrium each time the ball is thrown or caught. Asking him to throw the ball as hard as he is capable triggers aggressive bursts of movement from his arms and trunk leading to the need for dynamic adjustments. The therapist places her legs on his feet as a cue that he needs to find and maintain his balance without reverting to using stagger steps. For a person to truly possess functional walking control he needs to be able to stand still, move through his hips while in standing without losing his balance and be able to easily stop and start as well as change direction without needing excessive stepping to stay upright. In these pictures it is obvious at times that without the provided assist Caleb would fall. Once again the verbal cue to "pop" in his hips is being encouraged as a balance strategy. If Caleb can learn to stay forward in his hips he can "hang" on his Y-ligaments and feel stable. At the same time he can keep his knees straight; his knees, hips, shoulders and head aligned over his ankles and feet;



and his thoraco-lumbar junction dynamically stable and in good alignment. He will be able to stand and function using hip movements instead of staggering, falling or collapsing in his structures.

For home carryover this type of activity could be



performed with the child standing in a shoe board as a way to inhibit stepping. An even easier piece of equipment could be a box. Having the child standing in the box will inhibit his ability to step thus creating the need for him to use other strategies to stay balanced. Caregivers using either of these ideas need to provide appropriate assist to keep the child safe from falling since he will not be able to move his feet to balance or even to fall.

Following the work to activate different hip strategies



during standing and balancing activities lower extremity dissociation is once again assumed this time in standing. During this work Caleb requires consistent contact assist to keep his flexed leg on the surface and abducted at the hip. Given this assist he is able to use his arms for the throw and catch game and he seems to have better motor control for keeping his trunk upright. Teaching caregivers the importance of mastering single limb standing control not only for walking but for other activities of daily living may increase the compliance with promoting this work at home. Children need to be able to dissociate their legs to make transitions, climb stairs, get in and out of the car, dress, etc. Children also experience hip joint movement as well as stretching in the hip and leg muscles when the legs are positioned with one hip flexed and one extended. Since one of the major goals for Caleb is mastery of hip mobility for his stepping, doing simple things like assuming a dissociated position while brushing his teeth or washing his hands on a daily basis could drive his neurological system to attend to and integrate greater understanding about dynamic mobility between his pelvis and femurs.



Next a padded support is positioned between his legs and Caleb is directed to hold an overhead trapeze. From this wider more abducted position he is asked to shift onto one leg. The freedom of the trapeze allows rotation to occur in his trunk and notice how the pelvis and hip on the lifted side turn back. This is what he is being coached to do when he lifts one leg to step so that he doesn't feel like his

trunk and pelvis are shifting toward the side that is no longer on the floor. His alignment is not ideal on the stance side, but placing this obstacle between his legs prevents him from shifting at his thoraco-lumbar junction and allows him to practice and develop strategies for shifting onto one leg by activating muscles in his trunk and hips.

Requesting him to shift onto one leg and lift the other leg creates even more of a need for the stance leg to load and the hips to rotate on both sides. These images show he has better alignment and control for standing on his right side allowing his left leg to step. When he is required to stand on his left side his knee and hip both stay flexed and the poor alignment makes it difficult for needed rotation to occur.





Once the leg is lifted onto the surface and the lower extremity dissociation is exaggerated to a greater degree, many things fall apart. Now the flexed side pelvis is rotated forward regardless of the side he is shifted toward. He is no longer able to extend his knee and load through his

stance leg so his trunk is poorly oriented over an unstable base and he becomes primarily dependent on the arms pulling against the trapeze. This causes his trunk to move out of alignment making balance impossible. Although he does not need this degree of hip joint mobility and lower extremity dissociation in order to transition and move in his world, when these limitations exist in conjunction with his other motor challenges this child is at grave risk of developing contractures and/or orthopedic mobility and structure complications. Caregivers and therapists CAN prevent some complications but once the structure is set or muscles are contracted these permanent changes require more extreme interventions. Lower extremity dissociation can be promoted; hamstrings or other tight muscles can be stretched; alignment can be supported using equipment when necessary; and freedom of movement in his community can be achieved without needing to walk while relying on weak, possibly immature patterns. Balancing independence and functional control with attention to possible consequences is critical for everyone on the team to understand.

Walking while pushing the trapeze along the cable is practiced again following the single limb stance work. Initially he is instructed to hold the swing leg up for 3 seconds followed by kicking the leg out before placing it on the ground and loading. In the video it is obvious that every time a leg is lifted into swing his pelvis swivels across his body. He is able to return the pelvis closer to midline with the lifted leg in front of his body even when no assist is provided indicating he is more comfortable with the “out of control” mobility in his hips and he has a sense of where his body needs to align during stepping. Controlling pelvic-femoral dynamic rotation IS emerging. BUT, it needs a great deal of work to further organize and integrate his neuro-motor pattern instead of reverting to established patterns during walking. This will take time and a great deal of effort by the child, therapist and family. Is it worth the time and energy? Each family, child and therapist must make those decisions for themselves and hopefully the decisions are made consciously rather than made by obstacles or limiting circumstances being placed in their paths.





Given the luxury of an aide to assist in this session allows one of us to promote appropriate alignment and weight shifts while the other manipulates the legs through the leashes attached at the shoelaces. The lift and hold becomes active assisted work, and the person holding the leashes can manipulate the step length. Once the excursion of his pelvis is influenced by the aid from the

adults, note how the trunk and hip alignments improve. Is it any wonder a child like Caleb might perceive pelvic-femoral mobility to be a bad thing? Isn't he actually more unstable and "out of control" when his hips are free to rotate? Since his neuro-motor organization has been developed based on his movement experiences, could his brain be receiving feedback informing his body that when his hips are free to rotate his controlled stepping decreases and feels less stable? This brings us back to the ideology that "perfect practice makes perfect" and in order for Caleb to practice components he has difficulty using, he NEEDS to work with movement experts in order to progress in his motor control. Regardless of how amazing families are about doing home carryover, most parents are not movement experts and don't become movement experts even after years of education from therapists during therapy sessions. Expecting parents to help a child brush his teeth is much different than expecting a parent to learn how to use the sharp instruments to clean the child's teeth or fix a cavity. There are people that specialize in certain knowledge and in this case Caleb needs to continue working with therapists on a regular basis if he is going to master the evolving hip control needed for a more mature, less pathological gait pattern to emerge.



Following the cable means Caleb next has to climb the ramp. The therapist continues to influence the step length by pulling on the leashes as she walks backwards up the ramp. This

challenges Caleb to push through his stance leg in order to keep his body loading and moving forward and up. In the middle picture where he appears to be almost falling down the ramp, he feels the consequences of trying to rely on his arms and the support of the trapeze. He is able to recover his forward alignment and continue walking up the ramp using his hip rotation, active pushing through his dorsi-flexed foot and increased step length.



After all his hard work, a ride down the zip line ending on the trampoline provides a much needed but not very restful break.

With the therapist moving atop the trampoline, trunk and hip strategies are challenged if Caleb is successfully going to stay standing. Knowing his balance strategies are not sufficient to meet these demands the therapist provides an exoskeleton of assist to help Caleb feel the edges of his stability thus enabling him to stay standing.

To end the session Caleb demonstrates his independent stepping. In the image on the right he is showing how he “pushes the invisible walls apart”, but he does not maintain the shoulder girdle expansion and core activation seen here when he is actually stepping. More work to integrate these components is needed before he may be able to combine all the control necessary for walking using a mature integrated pattern.



One of the reasons the writer has reflected on frequency of therapy, focus on home carryover and an overall assessment regarding need for ongoing therapy is because this was the narrating therapists' last session working with Caleb. It is not where the video ends showing his motor control through the years, but following this session the author moved four hours away and Caleb began seeing new therapists at the same clinic. Making the transition was not extremely challenging for Caleb since he recently received 3 months of intervention from a different therapist. Communicating the changes Caleb made during the time he worked with this therapist and emphasizing areas of ongoing concern were a major part of the transfer process. Determining justifications for frequencies used in the past and reviewing home carryover activities Caleb and his family seemed to truly perform needed to be communicated in the paperwork and conversations passed along to his new therapists. More importantly, understanding the importance of allowing the new therapists to be in control even though we could communicate via modern technology meant letting go of decisions regarding therapy strategies emphasized, frequency of therapy, paperwork and documentation suggestions and the motor patterns Caleb would be allowed and encouraged to use. It became important to keep in mind that one offers what is possible at the time but must allow things to evolve without interference when circumstances change. Since a professional relationship existed with the new therapists, some video footage was provided and a few consultations were arranged so that this overview

practice will lead to perfect control and his practice most likely relies on compensatory patterns that don't feel atypical to his motor system.



During the upper extremity weight bearing exercise, notice how dynamic Caleb stays in his trunk when his weight is dumped into his shoulders and arms. The obliques activate even stronger during the diagonal work that occurs when Caleb reaches to place objects into the barrel. Performance of home carryover activities that facilitate trunk alignment and 3-dimensional holding is critical to balance the strong trunk collapse pattern Caleb is using during his walking.



These images highlighting the gait pattern Caleb uses show how his fixing strategies place him at grave risk of low back pain and range of motion challenges in his heel cords, hip flexors, hip adductors and hamstrings. The likelihood that Caleb will suffer more falls and possible loss of independent standing control also exists secondary to the patterns he is using. The exaggerated collapse through his lower back is stabilized by his bilateral humeral extension/adduction and internal rotation so he must keep his arms fixed to stabilize his body for standing and walking and this prevents him from using his arms for more typical motor skills. Allowing his upper body to collapse onto his lower body causes his rib cage to be very collapsed onto his diaphragm and this most likely will affect his diaphragmatic mobility possibly leading to decreased breath support and subsequent decreased stability for consistent speech production. This therapist believes functional use of the arms and excellent breath support for speech production is far more functional and important in an adult's and child's life than independent walking. During this session a list of possible pit-falls can be recorded and given