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Motor Coordination: Midline Crossing and Bilateral Coordination

Introduction 3

Section 1: Motor Coordination 3

Bilateral Coordination 7

Midline Crossing 8

Section 1 Personal Reflection 9

Section 1 Key Words 9

Section 2: Bilateral Coordination 10

Bilateral Coordination Milestones 13

Bilateral Coordination Assessments 17

Activities That Promote Bilateral Coordination 21

Section 2 Personal Reflection 25

Section 2 Key Words 25

Section 3: Midline Crossing 26

Midline Crossing Milestones 30

Midline Crossing Assessments 31

Activities That Promote Midline Crossing 31

Section 3 Personal Reflection 38

Section 3 Key Words 38

Section 4: Compensatory Strategies for Bilateral Coordination and Midline Crossing 39

Section 4 Personal Reflection 41

Section 5: Case Study #1 41

Section 6: Case Study #1 Review 42

Section 7: Case Study #2 43

Section 8: Case Study #2 Review 44

References 46

Introduction

As an essential performance skill, motor coordination is a trending topic in occupational therapy. Individuals of any age may experience motor incoordination, either as a developmental delay or a health condition. When this presents as a deficit, motor coordination must be addressed in the occupational therapy plan of care. Motor incoordination stands to impact anyone's occupational engagement and can impact an individual's quality of life. In order to effectively address motor deficits of all varieties, occupational therapists should be aware of the smaller skills that fall under this heading and how to incorporate them into treatment.

Section 1: Motor Coordination

References: 1, 2, 3

In a general sense, motor coordination is defined as the interrelated movement of multiple body parts as required for certain actions. Motor coordination can apply to gross motor skills (the movement of multiple body parts for larger tasks such as walking, jumping, and running) and fine motor skills (movement involving more than one body part for the sake of precise tasks such as holding objects, manipulating fasteners on clothing, and turning a steering wheel). Motor coordination is also inclusive of postural control, since a variety of core muscles must work together to allow someone to assume various postures. In addition, hand-eye coordination is a more specific subtype that involves fluidity of hand movement based on a person's vision. While therapists can address any of the above aspects of motor coordination, some of the motor coordination skills that impact their work the most are related to bilateral coordination and crossing midline. We will discuss these skills in greater detail later.

In order to demonstrate what is considered good motor coordination, each of an individual's body parts needs to achieve a specific set of kinematic parameters. These parameters are used to quantify the act of movement, and include certain positions, timing, velocity, acceleration, position, and smoothness of movement.

Someone may experience motor incoordination due to developmental delays or health conditions. The clinical term for motor incoordination is ataxia, which may appear either in a list of symptoms or the name of a health condition. Some health conditions and health events known to cause impaired motor coordination include:

- Alcohol misuse
    - Long-term alcohol misuse can lead to chronic motor incoordination
    - Someone withdrawing from alcohol may experience acute motor incoordination as part of delirium tremens, which is a severe form of withdrawal that causes sympathetic nervous system symptoms along with an altered mental state.
- Autism Spectrum Disorder
    - This developmental condition can impact communication, behavior, learning, and social interaction. Individuals with Autism Spectrum Disorder can also experience motor delays that can cause difficulty using both hands together in a functional manner as well as difficulty crossing the midline of the body.
- Autoimmune diseases
    - Systemic lupus erythematosus is just one autoimmune condition that may be associated with motor incoordination. Individuals with Celiac disease may also develop gluten ataxia, which is motor incoordination that results from ingesting gluten.

- Degenerative diseases
    - The most notable degenerative disease associated with motor incoordination is paraneoplastic syndrome. This condition involves the immune system having an exaggerated response to lung, ovarian or breast cancer or lymphoma.
- Cerebral palsy
- Dyspraxia (also known as developmental coordination disorder or DCD)
- Exposure to toxins
    - Long-term interaction with heavy metals such as mercury and lead can cause motor incoordination, as can poisoning from solvents and radiation. Depending on the length and severity of the exposure, motor symptoms may or may not be reversible once the person is no longer exposed to the toxin(s).
- Genetic conditions
    - There are several types of hereditary ataxia that cause motor incoordination as the main symptom. These include Friedreich's ataxia, ataxia-telangiectasia, and two types of ataxia that have oculomotor involvement. Ataxia-telangiectasia also affects someone's immune system and speech, so there are a range of other symptoms. Other genetic conditions that may cause motor incoordination include Niemann-Pick disease, tremor syndrome associated with fragile X, Arnold-Chiari malformation, and Wilson disease.
- Hypoparathyroidism
- Hypothyroidism
    - Some cases of hypothyroidism cause impaired gait, which is usually associated with motor incoordination across various parts of the

body. Depending on how impaired the person's thyroid gland is, motor symptoms may or may not be reversible once the person begins thyroid hormone replacement therapy and other pharmacological treatments.

- Infections
    - Human immunodeficiency virus (HIV), Lyme disease, coronavirus (COVID-19), and other infections can cause motor incoordination if there is neurological involvement.
- Medication side effects
    - Individuals may experience impaired motor coordination as a side effect of benzodiazepines, phenobarbital, anti-seizure medications, and chemotherapy medications to treat cancer. In most cases, this side effect will go away after someone stops taking the medication identified as the cause.
- Multiple sclerosis
- Parkinson's disease
- Stroke
- Tumors, especially those on or near the cerebellum
- Vitamin deficiencies
    - Individuals who are deficient in some B vitamins (specifically B1, B6, and B12) or Vitamin E are known to experience ataxia. This symptom often resolves once the vitamin deficiencies have been managed.

Bilateral Coordination

There are two specific skills that fall under the category of motor coordination: bilateral coordination and the ability to cross midline. Bilateral coordination refers to someone's ability to use both sides of the body (both arms or both legs) in a functional manner. This is considered a foundational motor coordination skill because it indicates both sides of a person's brain are communicating with one another and working together to govern movement. Bilateral integration skills typically start developing between 18 and 24 months of age and continue to grow until around the age of 4. Bilateral integration skills are controlled by several parts of the brain. Since bilateral coordination is a motor skill, the primary motor cortex, premotor cortex, and supplementary motor area on both sides of the brain all play a part. Both sides of the sensory cortex help someone process tactile input as they move. Individuals also rely on the corpus callosum and cerebellum for bilateral coordination. Since the corpus callosum serves as a go-between for the hemispheres, this structure will relay information between both sides of the brain and is an essential part of bilateral coordination. Helping with balance and the general regulation of motion, the cerebellum allows someone to engage in smooth, fluid movements.

Bilateral coordination begins as most other movements do. The supplementary motor area coordinates bilateral movements and programs complex movements – mostly those that are based on motor sequences someone has already learned. When someone is asked to carry out simple movements on one side of the body, the primary motor cortex and the primary somatosensory cortex in the contralateral hemisphere generate neural impulses. These impulses travel down the body from the brainstem to the spinal cord followed by the muscle the impulse was intended for. This leads the muscle to contract. Before someone carries out a movement on both sides of the body, the supplementary motor area on both sides of the brain generates a neural impulse as does the contralateral primary motor cortex and contralateral somatosensory cortex. Each of these impulses goes through the corpus callosum, which provides the brain with a

global understanding of the information being sent to the body. From the corpus callosum, the information then takes the same path from the brainstem to the spinal cord followed by the muscle it is intended for. This sequence produces muscle contractions on both sides of the body.

There are three types of bilateral integration. The first is symmetrical movements, which entails both arms or both legs moving in the same way at the same time. Some examples include squeezing a bottle using two hands and catching a ball in front of the body. Alternating movements are another large part of bilateral integration that require someone to engage each extremity in similar motions one after another. Pedaling a bike and swimming are some of the most clear-cut alternating movements. The last type is concurrent use of the dominant and non-dominant hand. This happens most commonly with writing, coloring, and similar fine motor tasks where one hand is doing the majority of the work while the other hand stabilizes or assists in another way.

Midline Crossing

As the second type of motor coordination, midline crossing involves being able to functionally and spontaneously cross the midpoint of the body. Someone who can effectively cross midline will be able to use their right arm and hand on the left side of their body and their left arm and hand on the right side of their body. This skill also extends to the lower body, so the same applies to being able to use the left leg and foot on the right side of the body and vice versa. In order to cross midline, someone must have intact bilateral coordination, so that skill should be developed before promoting midline crossing. The ability to cross midline is an important developmental milestone children should achieve before they develop hand preference. A typically developing baby should be able to cross midline between 8 and 12 months of age. Infants nearly always cross midline with their upper extremities before their lower extremities. This is because there is usually an obvious functional purpose for doing so, such as being able to cross midline in

order to reach for a desired object like a toy. As they grow, infants will engage in other activities that involve crossing midline in slightly more complex ways. This continues until 3 or 4 years old, which is when children need to cross midline the most for the purpose of coloring, drawing, and writing.

Section 1 Personal Reflection

Will someone who has difficulty crossing midline always have concerns related to bilateral coordination? Will someone who has concerns related to bilateral coordination typically present with difficulty crossing midline?

Section 1 Key Words

Ataxia - A clinical term used to describe coordination issues; people often experience ataxia as a symptom of a chronic or acute condition or it may be due to a medication side effect; ataxia may lead someone to have impaired balance, difficulty walking, trouble with fine motor tasks and carrying objects, and possibly even impaired eye movements

Contralateral - An adjective used to describe the opposite side of the body from a certain symptom, structure, or condition

Delirium tremens - A severe type of alcohol withdrawal characterized by hallucinations, high blood pressure, fever, an altered mental state, and intense shaking; someone may experience delirium tremens (also known as DTs) between two and five days after their last drink; DTs can be fatal if someone does not receive medical management

Kinematic parameters - Certain criteria (often spatial and motion-related) associated with physical movement

Section 2: Bilateral Coordination

References: 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28

As we mentioned earlier, bilateral coordination is considered the foundational motor coordination skill. For this reason, it is an important part of many functional tasks, including but not limited to:

- Using a rolling pin while cooking or baking (symmetrical)
- Jumping rope (symmetrical)
- Doing jumping jacks (symmetrical)
- Pulling up pants or socks (symmetrical)
- Clapping both hands together (symmetrical)
- Playing the drums with both hands (symmetrical)
- Catching a ball with two hands (symmetrical)
- Holding a book (symmetrical)
- Walking or running (alternating)
- Swimming (alternating)
- Doing animal walks (alternating)
- Riding a bike (alternating)
- Skipping (alternating)
- Climbing a ladder or stairs (alternating)
- Playing hopscotch (alternating)
- Cutting with scissors (use of dominant and stabilizing hands)

- Putting on a shirt or jacket (use of dominant and stabilizing hands)
- Tying shoes (use of dominant and stabilizing hands)
- Buttering bread (use of dominant and stabilizing hands)
- Stringing beads (use of dominant and stabilizing hands)
- Stirring in a bowl while cooking or eating (use of dominant and stabilizing hands)
- Writing and coloring (use of dominant and stabilizing hands)
- Manipulating fasteners such as zippers, snaps, and buttons (use of dominant and stabilizing hands)
- Opening containers (use of dominant and stabilizing hands)
- Self-feeding with utensils (use of dominant and stabilizing hands)

In order to understand the importance of bilateral coordination, therapists should look to the building blocks of fine and gross motor skills. While someone may possess *some* fine and gross motor skills in the absence of bilateral coordination, this deficit precludes someone from engaging in many two-handed motor tasks. This means that children who struggle with bilateral coordination often lack the hand stability and motor control to engage in writing and cutting tasks. A child who has impaired bilateral coordination may also shy away from reading, as it will be more difficult to hold a book or worksheet, turn pages, visually scan words and pictures, and move fluidly between lines of text.

If unaddressed, such a deficit can certainly impact their academic performance. Children with fluid bilateral coordination are also known to have better attention and memory along with more developed gross motor abilities. Being able to effectively use both hands together also enhances a child's visual perceptual skills such as visual attention, visual-motor integration, and overall visual sensation. More specifically, alternating bilateral movements are known to use more mental

resources from the cerebellum due to a greater need for stabilization and steadying. This means tasks that involve alternating bilateral coordination help improve someone's vestibular system as well as their capacity for spatially-related tasks such as posture and balance.

Rosa Guillamon et al. (2020) conducted a level III study that found school-aged children with good academic performance (specifically in math, language, English, and natural sciences) had better motor coordination as measured by performance in lateral jumps and overall motor index. While this study only establishes a positive correlation between motor coordination and academic performance, results suggest there is the potential for this link to be bidirectional. This would mean that children with poorer motor coordination skills more than likely do not perform as well academically.

Another level III study run by Macdonald et al. (2020) found a significant moderate positive correlation between math scores and motor composite scores (specific to fine motor skills) in early elementary school children.

Dadson et al. (2020) looked into the impact of screen time on children's hand function, bilateral coordination, and sensory function. This level III exploratory study found there was a significant moderate negative correlation between the total amount of a child's screen time, their visual-motor integration skills, in-hand manipulation skills, and bilateral coordination. This study also found that children who played with toys involving object substitution were somewhat protected from the negative effects of screen time, since these children experienced improvements in bilateral coordination and visual-motor integration.

Andalo et al. (2022) performed a level II study to determine if there is a link between a child's motor skills and their language development. Results showed that 2-year-old children had better fine and gross motor coordination along with bilateral coordination if they also had appropriate spatial vocabulary comprehension. This was also true for children up to 30 months of age, as the

development of these skills was considered dynamic as they grew along with one another.

Since bilateral coordination is such a formative skill, it stands to impact a range of functional areas across the lifespan. Adults with impaired bilateral coordination will likely experience difficulty dressing, driving, walking, and more. Research also suggests that bilateral coordination is uniquely impacted in adults who experience strokes due to the crossover that occurs in the brain and the idea of lateralization. Patients may demonstrate motor concerns related to bilateral coordination even if they do not experience hemiparesis or hemiplegia. This lends support to the idea that therapists should address bilateral coordination with equal importance in an adult population.

Bilateral Coordination Milestones

There are several important milestones that lead up to the development of bilateral coordination skills. At 2 months old, a typically developing baby should be able to move both of their arms and both of their legs. While there are no norms as to how this movement evolves, babies at this age should be able to move their upper extremities and lower extremities both separately and at the same time. Babies may even be able to move all extremities at the same time (e.g. moving their arms up and kicking their legs out to show they are happy or want to be picked up). However, a baby's movements at this age are still choppy, uncoordinated, and do not yet serve a functional purpose. If they are developing appropriately, 2-month-old babies should also be able to briefly spread their fingers. This movement is considered an early effort to open the hands, which prepares a child for early grasp patterns intended to hold and manipulate small objects.

From here, the next major motor milestone is at 4 months, which is when babies should be able to bring both hands to their mouth. Bringing their hands to their mouth is an important milestone in terms of sensory regulation, since this allows

babies to suck on their fingers or mouth pacifiers and toys in an attempt to self-soothe. The hand-to-mouth motor pattern also prepares babies to self-feed later.

When on their stomach, children around 4 months old are usually able to push up onto both elbows and/or forearms. This motor pattern prepares them for interacting with their environment (e.g. playing with toys, reaching for objects, etc.) while in a prone position. Being prone while using the arms also builds core strength and postural control for children as they grow.

At the age of 6 months, babies should progress to pushing up with straight arms when they are in a prone position. Using their arms in equal parts is an important part of bilateral coordination so this skill will be built upon even more in coming months. 6-month-old babies should also be able to lean on their hands for support when they are sitting. This is a perfect example of dominant and stabilizing hand use, since babies may do this with one arm while using the other arm for something else. Babies may also lean on both hands when sitting to compensate for their lack of core strength before they gain unsupported sitting skills.

By the time a baby is 9 months old, they should be able to sit without support. This means infants are expected to achieve additional fine motor milestones at this time due to their upper extremities having greater freedom. Babies at this age will begin to use a raking grasp to bring food and other small items closer to them. Whether they are standing or sitting, it is common for raking to be a symmetrical motor task at first. However, a baby's ability to rake will soon become more efficient and may even mimic activities that involve a dominant and a stabilizing hand. It is too soon for a child to develop hand dominance, as this happens between 2 and 4 years old, but a child will often use a raking grasp with one hand and attempt to get closer with their other hand. Another important motor coordination milestone babies learn at this age is the ability to move items from one hand to another. These manipulation skills serve to prepare a child to interact more precisely with toys and other objects in their environment.

When a baby turns 1-year-old, they should be able to pull themselves up into a standing position using both arms. 1-year-old babies should also be able to use their thumb and pointer finger together to pick up small objects. This is most often used to handle and feed themselves small pieces of food, but can also be used to pick up beads, small blocks, buttons, and other items they encounter while playing and exploring.

A 15-month-old child should be able to use all of their fingers to feed themselves. In terms of bilateral coordination, children at this age may do this with both hands at the same time. However, as they further develop, this activity later entails primarily using a dominant hand while stabilizing with the other hand. It's at this time that children should also begin to take a few steps on their own. Walking is a great example of functional motor coordination. Firstly, bilateral coordination of the lower extremities is necessary as legs engage in alternating movements to allow someone to cover ground. A baby's upper body must also gain coordination since they help with balance and pacing.

At 18 months, a child will continue to feed themselves with their fingers using greater efficiency. Children at this age will also begin using writing utensils (though they will mostly scribble on paper) and try to use a spoon, which are both examples of tasks that involve a dominant and stabilizing hand. It is not uncommon for 18-month-old children to switch hands when using feeding and writing utensils so these tasks are considered alternating at first. This is partly due to their lack of established hand dominance and also because these activities are more fatiguing than their typical tasks. In terms of other adaptive skills, 18-month old children will also independently drink from an open cup with some spillage. This requires symmetrical bilateral coordination.

By the time a child turns 2 years old, they should be able to run and kick a ball. Running requires alternating bilateral coordination while kicking a ball requires use of a dominant leg and a stabilizing leg to balance on. Children should also be able to walk up several stairs using only their legs (their hands should not make

contact with the steps) at this time. They may need some help ascending or descending stairs, but this shows even more development of their alternating bilateral coordination skills. 2-year-old children should also be able to independently eat with a spoon, and more consistent use of eating utensils should help them determine hand dominance in the near future.

30-month-old children are expected to make even more progress in tasks that rely on bilateral coordination. Adaptive skills such as dressing are further honed, as 30-month-old children should be able to remove pants, jackets, and other simple clothing by themselves, which requires use of a dominant and a stabilizing hand. Children at this age should also show more independence in fine motor prehension such as being able to uncap containers, unscrew lids, and turn doorknobs as well as turning single book pages. These tasks are additional examples of those that involve dominant and stabilizing hand use. Motor milestones that involve symmetrical bilateral coordination include jumping off the ground using both feet, and 30-month-old children should be able to do this on their own.

A 3-year-old child should be able to engage in even more activities that involve use of a dominant and stabilizing hand, including stringing beads and using a fork. At this age, a child should also possess enough symmetrical bilateral coordination to independently put on certain articles of clothing such as elastic-waist pants or a jacket. The following year is characterized by additional gains in fine motor prehension. Four-year-old children should be able to use a dominant and stabilizing hand to pour themselves water and undo buttons on their clothing. This is also when children further refine their pencil grasp and should be able to oppose their index and middle fingers with their thumb to hold a utensil when coloring or writing. In the way of symmetrical bilateral coordination, milestones at this age include catching a large ball with average accuracy.

Children who are 5 years of age will demonstrate the ability to hop on one foot and fasten buttons on their clothing - both with the help of a dominant and a

stabilizing hand. From this point forward, children have mostly mature motor skills that are expected to be further refined as they grow.

Because bilateral integration relies heavily on the development of sensory abilities (namely vestibular, visual, and proprioceptive), providers should keep in mind when these functions are mature. The body's sensory systems should be fully developed between 6 and 8 years of age, which is also when children should be motivated to acquire new skills and do things on their own. It's at this time that children should feel more comfortable transitioning between activities, being in group situations, and navigating a variety of environments such as the playground and their classroom. A child's organization should also be functional by this age, which should help with motor development.

Bilateral Coordination Assessments

Functional observation is widely considered one of the simplest and most effective ways to determine a patient's bilateral coordination skills. There are a range of basic tasks therapists can engage patients in to informally assess this type of coordination. If a therapist is working with a child in a school or clinic setting, they can ask them to play catch with a ball, write their name, or climb up a slide on the jungle gym. Hospital- or SNF-based therapists can glean a patient's capacity for bilateral coordination through ADLs such as dressing at their bedside and washing their face at the sink. Therapists in residential settings can also take a mental note of how patients use their upper and lower bodies while transferring from one spot to another or when reaching for an item on their tray table. Each of these activities (and more) offers therapists the opportunity to observe various types of bilateral coordination.

In the way of formal bilateral coordination testing, therapists have several assessment options depending on the patient's age, diagnosis, and clinical presentation:

- Alternating Hand Movements Test (AHM)
    - This test is primarily used to test for the presence of a deficit called dysdiadochokinesia. If a patient is unable to flip their hands from back to front either simultaneously or one at a time, they have this deficit. The AHM sheds light on someone's bilateral integration due to its emphasis on alternating motions.
- Bilateral Task Assessment
    - This is intended for patients recovering from stroke and is mostly used in inpatient settings.
- Both Hands Assessment
    - This test is used to assess bilateral integration and coordination in children who have bilateral cerebral palsy.
- Bruininks-Oseretsky Test of Motor Proficiency (BOT-2)
    - This test was designed for pediatric and young adult patients ages 4 to 21 and has basic features that look at upper limb coordination in isolation along with coordination of the upper and lower limbs together. The BOT also has a subtest specifically for bilateral coordination.
- Comprehensive Coordination Scale (CCS)
    - Measures both unilateral and bilateral coordination and is intended for individuals with neurological disorders.
- Developmental Coordination Disorder Questionnaire (DCDQ)
    - This screening tool comes in the form of a parent checklist and should be used on children between 5 and 15 years old. The DCDQ

covers fine and gross motor tasks, many of which are bilateral in nature.

- Fugl-Meyer Assessment of Motor Recovery
    - The Fugl-Meyer measures the amount of motor skills someone regains after experiencing a stroke. This assessment is intended for patients ages 13 and up; test questions look at balance, general motor function, sensory function, and ADL performance as it pertains to coordination and range-of-motion.
- Hand Assessment for Infants
    - The Hand Assessment for Infants is intended for children between 3 and 12 months of age who are at risk of developing cerebral palsy. This test tracks a child's tendencies for using both hands together and each hand on its own. This assessment offers a score for each hand so providers can determine which hand a child is using more often, if that is the case.
- International Cooperative Ataxia Rating Scale (ICARS)
    - This measure is used to assess symptomatology related to hereditary ataxias. ICARS has subtests for dysarthria, limb ataxia, oculomotor disorders, and disturbances of postural control and gait.
- Lower Extremity MOtor COordination Test (LEMOCOT)
    - The LEMOCOT was developed with a focus on the lower extremities, so OTs may not use this measure as much as some other bilateral coordination assessments. However, they should be aware that it can be used with individuals who have temporal and spatial gait inaccuracies. This includes diagnoses such as SCI, stroke, schizophrenia, Parkinson's disease, ataxia, and a range of psychiatric conditions.

- Peabody Developmental Motor Scales (PDMS)
    - The PDMS can be used on patients from 0 to 5 years old. While this assessment does not directly measure bilateral coordination, one of its subtests covers visual-motor integration. These results can be used to gauge a child's hand-eye coordination and similar skills.
- McCarron Assessment of Neuromuscular Development (MAND)
    - This assessment can be used on patients between 3 and 16 years old and includes a range of bilateral tasks under the fine motor category.
- Mini-Assisting Hand Assessment (Mini-AHA)
    - The Mini-AHA was designed for children 8 to 18 months of age who have signs pointing toward unilateral or hemiplegic cerebral palsy. This test measures a child's habits in terms of using their affected hand and using both hands together, specifically during play activities.
- Motor Activity Log (MAL)
    - The standard version focuses on unilateral motor tasks and is intended for adults who are in the sub-acute and chronic stages of rehab after a stroke. There is a pediatric version of this assessment measure as well as a version that contains some bilateral tasks (MAL-26 contains some bilateral tasks).
- Scale for the Assessment and Rating of Ataxia (SARA)
    - This test is intended for adults with spinocerebellar ataxia, ataxia as a result of stroke, and Friedreich's ataxia. The SARA measures the effect of ataxia on unilateral and bilateral coordination.
- Sensory Integration and Praxis Tests (SIPT)

- The SIPT contains a bilateral motor coordination subtest.

Activities That Promote Bilateral Coordination

Some patients may present to therapy with deficits that respond best to specialized interventions or the use of certain medical devices. For example, a patient with acute pain may benefit the most from ultrasound or electrical stimulation to manage their discomfort and encourage the body to heal itself. Since bilateral coordination is a motor skill, many interventions that address deficits in this area involve therapeutic activities focused on the use of both hands and functional practice of actual tasks that require someone to use both hands in some capacity. Some examples of these functional and therapeutic activities include:

- Air biking
- Animal walking (e.g. frog, rabbit, elephant, snake, dog)
- Bouncing a ball off the wall repeatedly and catching it
- Braiding your own hair or braiding someone else's hair
- Building a tall tower of blocks or structures with pop tubes
- Buttoning a shirt
- Cleaning a table or windows with a cloth in one hand and a spray bottle in the other
- Completing in a game of Twister with a peer
- Completing any upper body exercise and lower body exercise at the same time
- Completing activities while in quadruped

    - Placing one hand flat on the ground and using the other hand to place stickers in a certain design on paper
    - Placing one hand flat on the ground and using the other hand to collect small items (e.g. pom poms, coins, figurines, etc.) and place them in a container
- Creating a tie-together fleece blanket or article of clothing using a similar method
- Cutting paper, play-doh, or thicker objects with scissors
- Dealing and shuffling playing cards
- Doing jumping jacks
- Dynamic reaching while stepping in one direction and reaching in the opposite direction
- Feeding a tennis ball monster
- Filling a pill organizer
- Finding and stepping on specific shapes or colors of floor tiles while walking
- Folding cardstock to make paper airplanes, origami, or fortune tellers
- Folding clothing at the edge of a bed or a tabletop
- Forming play-doh into a ball by rolling it on a flat surface or in between two hands
- Frosting cupcakes or cookies
- Kneading dough with a rolling pin while cooking
- Lateral stepping over objects within an obstacle course

- Making music (e.g. beating a drum, shaking maracas, holding on to a tambourine)
- Making snow or sand angels, or pretending to do so if you're inside
- Manipulating stretchy bands in a defined way (e.g. in a circle)
- Mixing food items in a large bowl
- Opening pill bottles
- Painting with a squeeze bottle
- Planking in a chair or against the wall while performing alternating shoulder taps
- Playing hand clapping games
- Playing hopscotch
- Playing Simon Says and mirroring a therapist's movements focused on bilateral coordination
- Popping bubbles with both hands or trying to catch them in an open book
- Practicing tug-of-war
- Propelling oneself on a scooter board using both hands
- Pulling oneself up a jungle gym using a rope, a climbing wall, or other manipulatives
- Pushing a laundry basket, grocery cart, wagon, or other similarly-sized items
- Pushing a peer on a swing with both hands
- Scissor walking
- Sewing a variety of clothing items

- Sitting unsupported while tossing a ball, juggling, or completing bilateral bicep curls
- Spreading a condiment on bread while cooking
- Standing balloon tap
- Spelling words by stepping on letters one at a time positioned on the floor
- Stringing beads
- Tearing a piece of paper into strips
- Teasing and separating cotton balls
- Threading washers onto bolts
- Throwing a ball using a velcro catch set
- Tossing a ball in a hoop or to another person
- Tossing rings onto a stake
- Tying shoelaces
- Using a can opener while preparing a meal
- Using a fishing rod with a magnet to locate and pick up small items
- Using a knife and a fork to cut through play-doh, kinetic sand, or food
- Weaving pieces of paper together

There are several considerations therapists should be mindful of when implementing therapeutic and functional interventions with patients who have deficits in bilateral coordination. Firstly, therapists should break down all activities into simple steps to ensure patients can comprehend and perform them correctly. This will be key not only for a patient's success, but also for their motivation.

In accordance with the principles of motor learning, therapists should emphasize repetition for optimal carryover. This should be accounted for at all points during the plan of care. However, repetition is especially crucial with tasks that require precision, since a high level of repetition is necessary to rewrite memories related to motor patterns. In addition, therapists should provide assistance in the form of sensory cues (visual, tactile, verbal, and proprioceptive) whenever necessary to increase a patient's motor performance. Therapists can offer auditory instruction along with gentle, non-intrusive touch. Patients should also be positioned so they can view their posture and actions in real time, which will help with body awareness and ensure long-term carryover. Some patients may even benefit from using a mirror to assist with proprioceptive input.

It's also a good idea for therapists to gradually upgrade bilateral coordination activities by increasing the speed of tasks over time. Rest breaks should always be incorporated and are most appropriate when planned after two or three repetitions in an effort to avoid fatigue.

Section 2 Personal Reflection

If a therapist wanted to address a patient's concerns about bilateral coordination related to dressing, what therapeutic activities might they start with?

Section 2 Key Words

Dysarthria - Weakness of oral motor musculature that leads to difficulty speaking (most often slurred or slowed speech)

Dysdiadochokinesia - A neurological deficit characterized by the inability to quickly and accurately alternate between flipping one hand from front to back while doing the opposite motion with the other hand

Lateralization - The distinction between the processes and functions of each side of the brain; while the left and right brain have somewhat different functions, they work together constantly to create certain behaviors and motor patterns while interpreting various sensations and other stimulus

Section 3: Midline Crossing

References: 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40

Another major aspect of motor coordination is midline crossing, which incorporates many of the same components that bilateral coordination does. Midline crossing involves functionally being able to cross the body's midline efficiently and smoothly. The body's midline is an imaginary line that runs down the entire center of the body from a person's head to their feet. When someone is able to cross midline, they can spontaneously use their left hand on the right side of their body and their right hand on the left side of their body. This skill also comes before a child develops hand preference, since they should be able to experiment with using each hand for various activities. Some functional examples that require someone to cross midline include tying shoes, writing sentences or making coloring a large poster (for example making long curved strokes for a rainbow), and putting a belt through loops in your pants.

Midline crossing helps people with a range of functional activities. Handwriting is one of the most obvious tasks that is impacted by crossing midline. Richmond & Marks (2019)'s level VII paper states that children who have difficulty with this skill often switch hands, turn their paper, or cram letters together when they are presented with the need to cross midline while writing. However, not being able to cross midline has more than a functional impact. At its core, midline crossing is an indication of how one side of the brain is communicating with the other. In unspecified qualitative research, Gorla et al. (2020) states that midline crossing helps with the creation of neural circuits. There is a delicate balance between this

infrastructure – axons must be able to cross midline but cannot recross to allow midline connectivity.

Tasks that involve midline crossing also require more cognitive processing time, so it's understandable that many individuals with neurological disorders struggle with these tasks. This is not the only population that may experience difficulty crossing midline. Tószegi et al. (2023) performed a level IV study and found children at risk of learning disorders displayed a range of sensorimotor deficits compared to typically developing children, including impaired bilateral coordination, postural imitation delays, difficulty crossing midline, and an inability to maintain standing balance with eyes open. These concerns along with learning disabilities themselves will undoubtedly impact a child's academic performance, which lends support to occupational therapy's role in remediating such deficits. Padilla Melendez (2019) wrote up a level IV report on the connection between Autism Spectrum Disorder (ASD), retained reflexes, and their impact on a child's motor skills and functional abilities. Children who have retained reflexes, specifically the asymmetric tonic neck reflex (ATNR), are also known to demonstrate deficits in crossing midline. This may be a persistent concern in children with ASD, ADHD, and dyspraxia. In these instances, reflex integration therapy can assist with the root cause of this motor deficit.

In addition to ASD, other neurodevelopmental conditions have been linked to midline crossing among other motor skills. Begum Ali et al. (2020) conducted a level IV study exploring early motor differences (including but not limited to skills such as crossing midline) between infants at risk of ASD and infants at risk of ADHD. Results found that both at-risk populations crossed midline less than not-at-risk peers up until 10 months old. Follow-ups were conducted at 14 months old, 2 years old, and 5 years old. Researchers found no differences between the motor development of infants at-risk of ASD compared to not-at-risk peers at each of these ages. These results align with those of dated studies that found a child's ability to cross midline spontaneously increased with age between years 4 and 8. However, this study found that crossing midline could predict ADHD traits in 2-

year-old participants. Researchers ruled out general motor skills and hand dominance as reasons for this pattern, and felt confident in stating that multisensory integration skills and a neurobehavioral shift are likely the root cause of the motor discrepancies observed in this study.

As we mentioned, crossing midline is essential for handwriting and may be impacted by developmental delays in this area. A level I study by Zarifah Mhd Zain et al. (2022) offered a scoping review of essential prewriting interventions intended to help children both with and without developmental disabilities. The review covered pre-writing interventions, prerequisite handwriting skills, writing protocols and interventions, and specific applications for those interventions. This review placed a particular emphasis on prerequisite handwriting abilities and outlined five main skill groups: fine motor development; visual tracking; tool manipulation, midline crossing, and use of one's dominant hand; creating basic strokes; and form recognition. With midline crossing being such a pivotal motor skill for handwriting, therapy focused on prewriting should encompass tangible and digital interventions for optimal success.

In the way of therapies that rehabilitate crossing midline deficits, Jacobs et al. (2021) performed a level VI study, which yielded positive outcomes when children with this motor delay participated in a remote, web-based OT treatment. Some studies have found success in improving crossing midline with different age groups. A similar level IV study by Singh et al. (2022) found augmented reality analytics can be used to measure frequency of crossing midline. This has many applications for addressing crossing midline in both the assessment and treatment processes.

There is some research on the functional incorporation of crossing midline within therapies. A level III study (single-arm RCT) by Sanjeevkumar et al. (2021) looked at whether or not simulated functional task programs could increase executive functioning and ADL performance in elderly individuals with mild cognitive impairments. The program involved 12 sessions over 4 weeks. Results showed

improvements in Canadian Occupational Performance Measure (COPM) scores as well as gains in executive function, balance, and ADLs. The study took a close look at specific motor skills such as midline crossing, bilateral coordination, and task sequencing as they related to bathing, eating, dressing, and grooming. Dated studies suggest that midline crossing inhibition (which is the official classification for this deficit) can be improved upon even in older adults without pathological conditions. This lends support to the concept of neuroplasticity and how brain-related changes are possible across the lifespan.

Midline crossing has also been connected to other motor coordination skills. Liang et al. (2019) performed a level II study, which found that being able to cross midline is associated with quicker reaction times regardless of hand preference. Reaction time is important for a variety of functional tasks such as driving and sports, and also serves a protective purpose in shielding individuals from injury.

Law et al. (2019) performed a level II study to determine the impact of functional task exercise on cognitive function in older adults with mild cognitive impairment. One group received 8 weeks of functional task exercise, a separate group received 8 weeks of exercise training, and another group was waitlisted. The two intervention groups consisted of various types of task-related movement, including bimanual motions, unilateral motions, midline crossing, and task switching. At the end, the functional task exercise group demonstrated more improvements in memory, caregiver burden, and functional performance (specifically related to ADLs) compared to the other two groups.

In a level II study, Saidmamatov et al. (2022) explored how motor skills training can affect midline crossing in children diagnosed with developmental coordination disorder (DCD). While most motor skills programs are deemed effective to help kids with DCD, there isn't much outcome information on crossing midline. In this study, right-hand dominant preschool children with DCD took part in a 10-week motor skills training program while typically developing right-hand dominant children did not receive intervention. At the end of the study, children in the

experimental group demonstrated more use of their opposite hand and less right-hand use at midline compared to the control group. During observational reporting, the intervention group also demonstrated fewer right-hand reaches than the other group did. This shows that motor skills programs not only had a positive impact on crossing midline in children with DCD, but also caused their motor behaviors to more closely mimic those of typically developing children.

Collectively, evidence states that evaluating crossing midline from both a spatial and temporal perspective is best practice. Spatial features are defined as changes in space due to movement. Related to crossing midline, this most notably includes range of motion at the shoulder, elbow, and hand during the movement. Temporal features are those that relate to time. As a result, temporal features associated with crossing midline include overall speed of movement, timing one's actions when reaching for an object in motion, and timing related to moving each joint (e.g. moving the shoulder before the hand). Adding the temporal component became more crucial and more widespread in the last two decades. This allows for more comprehensive evaluation. For example, when assessing functional reach, the spatial features (namely, the position) of the item often impacts what extremity someone uses. It's less natural to use the contralateral hand when reaching for something far away. This is why temporal features should also be taken into consideration.

Midline Crossing Milestones

Before using any of their extremities, typically developing babies will first cross midline with their eyes when they are between 3 and 4 months old. Children learn to roll at 6 months old and will need to cross midline with their arms in order to successfully do this. Once they have mastered crossing midline with their eyes, babies will use this visual input to help them reach across the body between 6 and 7 months of age. This often starts with crossing midline to play with their own feet. Typically developing babies will intentionally cross midline to reach a desired

object between 8 and 12 months old. From this point on, children will gradually engage in more complex tasks related to crossing midline. This continues until 3 or 4 years old, which is when a child begins drawing. Drawing and related activities rely heavily on the ability to cross midline. Children also begin to put on pants and jackets themselves around 3 years old, which requires them to cross midline. Crossing midline should be a fluid movement by the time a child is 4 years old. This skill will be further honed as children learn to read, since this involves following sentences with their eyes or fingers as they read across a page.

Midline Crossing Assessments

Midline crossing is most often assessed from a lens of functional observation, as there are a range of common daily tasks that prompt someone to cross midline. In addition, there are a few standardized assessments that can assist in evaluating a person's ability to cross midline independently:

- Bishop's Card Reaching Task
- Finger/Limb Crossing Test
- Space Visualization Contralateral Use (SVCU)

Any of the activities below can be used to informally test midline crossing as well as promote the skill during treatment and outside of sessions.

Activities That Promote Midline Crossing

- Adding dots or small symbols in a line to the right margin of a piece of paper with the left hand (and vice versa)
- Aiming at targets with a squirt gun while holding it with both hands
- Completing a large jigsaw puzzle on the floor or the table with emphasis on reaching across the surface to grab and place pieces where they belong

- Completing an object find while seated on a ball or chair where your feet can touch the floor
    - Place objects on either side and only use the left hand to get things on the right side and vice versa
- Dancing to music with scarfs or ribbons in both hands
- Doing cartwheels in slow motion with an emphasis on segmental body movements
- Drawing on a horizontally-oriented piece of paper while holding it against the wall with the opposite hand
- Erasing a large whiteboard or chalkboard with a towel, eraser, or wipe
- Forming words or sentences on a wall or other vertical surface by removing post-it notes stuck to the arms, legs, and torso and placing them on the wall
- Giving yourself a big hug by crossing arms and squeezing
- Going through multi-step sensory obstacle courses with each step containing various midline exercises to the tune of fast-paced music
    - Arm and leg brushing: While sitting or standing, place a flat hand on the opposite shoulder and run it along the length of that arm until reaching the opposite hand; switch sides and do the same with the other arm as well as both legs; perform several repetitions for each step
    - Arm scissors: While sitting or standing, hold both arms straight out to each side; keep each arm straight while crossing them in an “X” in front of the body; return each arm to their respective side and repeat the same process but with the opposite arm on top; keep alternating and completing this sequence in a rhythmic motion

- Chalk line walk: Stand parallel to a wall, fence, or other vertical surface; walk along the surface with one arm across the body and drawing a straight line on the surface; at the end of the wall, turn around and continue the line in the opposite direction
- Cherry picker crunches: Lay on the ground flat-back and bend slightly forward at the hips to raise both arms off the ground, then move a toy or other object from left to right across the body repeatedly
- Crunches: Lay on the ground flat-back and perform standard crunches; at the end of each repetition, touch the right elbow to the left knee, then the left elbow to the right knee before laying flat to do a basic crunch again; complete this sequence in a rhythmic motion
- Figure eight ball pass: Stand with both legs spread apart and hold a small ball with one hand; reach through the legs and pass the ball to the other hand, which will be positioned behind the legs; bring the ball forward and around the other leg to give it back to the other hand; complete this sequence in a rhythmic motion; this activity can eventually be upgraded to a reverse figure eight pattern
- Firecrackers: While sitting or standing, flatten both hands and press both palms against one another in front of the stomach as if to do a high-five; keep both hands in this position while moving them smoothly from side to side; after 10 repetitions of this, keep both hands in the same position and move both arms straight up above the head; when done reaching upward, clap both hands loudly like a firework explosion, then wiggle the fingers while moving both arms downward to create firework sparkles
- Forward bends: While standing, bend forward at the waist and touch the right foot with the left hand; stand back up tall, bend forward at

the waist again, and touch the left foot with the right hand; continue repeatedly in a rhythmic motion

- Hula hooping for various periods of time while stopping and starting in between, since the starting motion requires someone to cross midline
- Long sit ball tap: While sitting with both legs straight in front of the body and slightly spread, hold a medium-sized ball with two hands and follow a pattern given from someone else by tapping the ball on the right side of the legs, in between the legs, and on the left side of the legs
- Macarena dance
- Rollbacks: While sitting on the floor, bring both knees in to your chest and wrap both arms around them; keep the arms where they are and lean back until rolling into a flat-back position; try to return to a sitting position without releasing either arm; to make it even more difficult, do the same steps with both hands on the forearms
- Sled pulling, ideally with a person or items on it to add resistance; this can also be done with a large blanket with objects or a person on it, or with a weighted blanket
- Standing crunches: While standing up straight with a flat back, place the right elbow on the left knee, then return to standing straight; then place the left elbow on the right knee and return to standing straight; continue repeatedly in a rhythmic motion
- Stand and place the right elbow on the left knee and vice versa
- Toe touches: While sitting down with both legs spread apart, reach over and touch the left foot with the right and left hand at the same time; repeat the same motion on the opposite side

    - Tug of war
    - Windmills: While standing with both feet spread apart, straighten both arms out to each side then reach down to touch the left foot with the right arm; return to the starting position and repeat the same motions with the right foot and the left arm; continue repeatedly in a rhythmic motion
- Having a scavenger hunt with a flashlight
    - Walk along a straight line of tape on the floor while holding a flashlight with both hands; have someone call out various objects to find in the room and point the flashlight at them while keeping both feet straight along the line on the floor
- Helping a friend put a temporary tattoo on one's own upper arm
- Hitting a ball with a bat or a pool noodle
- Holding a large rope with two hands and turning it until the whole rope moves in a circle; the other end of the rope should be attached to a tree, doorknob, or other stationary surface
- Kicking a ball diagonally toward a target or on a string with alternating hands and feet
- Making large figure eight motions with the body by bending over at the waist and swinging both arms from side to side
- Moving cars, trains, trucks, and other vehicles across roadways, either through tracks and roads on a rug, constructed pathways, or those made of play-doh
- Passing an object (ball or bean bag, ideally) from one person to another relay-style using both hands

    - Starting positions can be sitting back to back or sitting side by side in a line
- Playing catch by rolling balled up socks to one another
- Playing flashlight tag with people in a large room
    - Each player must hold the flashlight with both hands while moving it to illuminate other players
- Playing hand clapping games, Twister, a large floor-based game of tic-tac-toe while kneeling at the center of the board or side sitting in the middle of the board
- Playing a wall taping game
    - Place painter's tape in the shape of a plus sign on a wall or other vertical surface; tape shapes, letters, numbers, words, pictures, etc. in each of the four spaces; have someone call out various items that are posted on the wall and reach for them (either tap them or remove them) with the farthest hand from the space
- Pulling resistance bands in diagonal motions with both arms or one at a time
- Pushing oneself forward on a scooter board using a plunger or similar tool as an aid
- Putting deodorant on the left underarm using the right hand and vice versa
- Reaching in various directions to catch butterflies or other bugs in a net or jar
- Removing cards from one hand using the other hand while playing any card game

- Removing stickers or clothespins from various body parts by reaching around repeatedly
- Rocking a pretend baby, doll, stuffed animal, or small pet in both arms
- Rubbing in lotion or sunscreen on the arms and legs
- Sliding magnets across the fridge, a large board, or a garage door
- Sorting items into various containers using only one hand and switching hands halfway through
- Tapping moving targets
    - Someone holds two differently-colored balloons, plates, pieces of paper, etc. in front of the person and moves the targets throughout the activity while giving verbal instructions as to which one the other person should tap with their hands
- Threading large beads on a long string
- Throwing a frisbee toward a target or a peer who will throw it back
- Tossing bean bags in a variety of ways (e.g. reaching around the back, rotating side to side, bending and throwing through the legs)
- Using a bubble wand while moving it back and forth across the body
- Using a hockey stick to pass or shoot a ball, puck, or other objects
- Using a sit-and-spin while intertwining both hands to get it to move in a circular motion
    - This same activity can be done with a scooter board
- Using a tennis racket with both hands to hit a ball or other objects
- Washing the walls with one hand at a time using large circular motions

- Washing and drying a car using both hands moving in all directions while trying to keep the body in one spot and reaching to what needs to be cleaned
- Watering the garden while holding the hose with both hands and moving it where the water needs to go
- Wiping a table dry using a towel or washcloth and only one hand at a time
    - Use water to clean and dry the table or use shaving cream for added visual motor and sensory input that many kids would enjoy
- Writing words or names in the air above your head with one hand at a time

Section 3 Personal Reflection

How can you upgrade some of the above activities to further enhance motor skills?

Section 3 Key Words

Spatial features - Features related to changes in space; when they pertain to movement, some spatial features include step length, step width, stride length, and range-of-motion of each joint involved in functional reach

Temporal features - Features related to timing; when they pertain to movement, some temporal features include cadence, timing of moving the shoulder sooner than the elbow when reaching for an object

Section 4: Compensatory Strategies for Bilateral Coordination and Midline Crossing

References: 38, 39, 40, 41, 42, 43, 44, 45

As part of their training, occupational therapists should be aware of signs that a patient may be compensating for certain deficits. Compensatory behaviors are a natural tendency for most people, as they attempt to adapt and find ways to function in spite of not having certain skills. Therapists often tend to correct these types of behavior early on in a patient's plan of care before they determine what mode of therapy the patient will benefit from the most.

For example, if a child has a developmental delay that causes them difficulty crossing midline, therapists will most likely work to strengthen and encourage that skill over time. On the other hand is a patient who has residual hemiplegia, visual neglect, and difficulty with bilateral coordination as a result of a stroke that occurred 6 years ago. If this patient has been receiving therapies for several years following their stroke and is still yet to use both hands together in a functional manner, compensatory strategies are indicated.

Compensatory strategies for motor coordination deficits, including both bilateral coordination and midline crossing, may include the use of assistive technology, environmental modifications, or adaptive techniques to help with functional tasks. These strategies include but are not limited to:

- Changing the position of objects during tasks (e.g. placing a piece of paper vertically instead of horizontally when writing on it or reading from it)
- Leaning to the side or adjusting one's head position when writing or engaging in other tabletop tasks
- Rotating the trunk or other parts of the body to complete certain functional tasks focused on one side of the body

- Switching hands when doing a functional task that requires midline crossing
- Using both hands for a task that may only require the use of one hand

In the realm of assistive technology and adaptive equipment, therapists can recommend some of the following tools for patients with deficits related to midline crossing and/or bilateral coordination:

- Automobile flip assist handle
- Button hook
- Divided dinner plates and bowls
- Doorway flip assist handle
- Dressing stick
- Dycem as a stabilizer under existing items that would traditionally need to be held by hand
- Electric can opener
- Hand controls for driving if midline crossing deficits impact the lower body
- One-handed cutting board with attachments to assist with meal preparation and adapted feeding
- One-handed grip toggle
- One-handed jar opener with added grip
- One-handed mobile gaming controller
- One-handed nail clipper
- One-handed palm grip tool for steering wheels
- One-handed tabletop scissors with an adjustable base

- Rocker knife
- Scoop plate with handles
- Soda can tab opener
- Spinner knobs for steering wheels (tri-pin, single pin, etc.)
- Wireless book page turner
- Zipper pull

Section 4 Personal Reflection

How can therapists effectively incorporate environmental modifications along with adaptive equipment into treatment for a patient who cannot cross midline?

Section 5: Case Study #1

An occupational therapist just began working with a 6-year-old girl who was just diagnosed with ASD and also demonstrates a range of motor concerns. Her main presenting problems are related to sensory seeking behaviors and midline crossing. The therapist notices these motor deficits have the most impact on the child during writing and upper body dressing. The child is not motivated for writing tasks and is resistant to therapist and caregiver assistance when she does participate in these tasks. For this reason, the OT is having difficulty addressing this goal during sessions.

1. What is the best approach for the therapist to better engage this child?
2. Would this child benefit from compensatory strategies, assistive devices, or skill building to assist with midline crossing? Why or why not?

3. What activities might be of interest and can be incorporated into treatment sessions?

Section 6: Case Study #1 Review

This section will review the case studies that were previously presented. Responses will guide the clinician through a discussion of potential answers as well as encourage reflection.

1. What is the best approach for the therapist to better engage this child?

   Since the therapist just started working with this child, the provider may need to take some time to build rapport and learn the child's interests. The therapist may want to have the child lead the first few sessions not only to observe her behaviors and tendencies, but also to take note of preferred and non-preferred activities. The therapist can also speak with the child's teacher, parents, and any other providers she may be working with to gain insight into what motivates her. The therapist can then use aspects of those activities during sessions.

2. Would this child benefit from compensatory strategies, assistive devices, or skill building to assist with midline crossing? Why or why not?

   Due to the child's age, skill building will be the best approach. Compensatory strategies are not indicated because the child does not have any lasting motor conditions that would prevent them from improving their ability to cross midline. Assistive devices are also in alignment with a compensatory approach to therapy, so they are also not suitable for this child.

3. What activities might be of interest and can be incorporated into treatment sessions?

The therapist may need to take a more discreet approach to addressing midline crossing. Since the child is not particularly interested in or motivated for writing, the therapist may need to focus more on games and therapeutic activities while they are building rapport. For example, if the child is interested in more physically-oriented activities, the therapist can lead her through a sensory obstacle course that involves a range of exercises focused on midline crossing. The therapist should start simple and include exercises such as arm and leg brushing, the chalk line walk, and sled pulling. The sensory obstacle course also serves the added benefit of offering sensory input to help the child regulate her behaviors, which assists with her other therapy goal. The child may also enjoy giving herself hugs and turning a rope tied to a doorknob for added sensory input.

Section 7: Case Study #2

A 71-year-old man recently moved from a single-story home where he lived alone to an assisted living facility so he can receive more support. He has needed more help with ADLs after experiencing a left MCA stroke 1 year ago. The patient was also referred to outpatient occupational and physical therapy last week. He presented to OT with concerns related to dressing, meal preparation, and using his upper body to push his walker throughout his home and the community. Before seeing the patient, the OT performs a chart review and reads that the patient is experiencing continued right hemiplegia and hemiparesis. His medical records also state that he had been receiving PT and OT continually since his stroke and was recently discharged due to a lack of progress. Based on his therapy discharge note, the patient only has 25% range of motion and strength in his RUE. His OT goals at that time were related to strengthening and range of motion with no mention of functional goals.

1. What therapy approach may be helpful for this patient?

2. What strategies or adaptive equipment can help this patient with his functional goals?

3. Is this patient able to live alone safely at his current level of functioning?

Section 8: Case Study #2 Review

This section will review the case studies that were previously presented. Responses will guide the clinician through a discussion of potential answers as well as encourage reflection.

1. What therapy approach may be helpful for this patient?

   Based on the patient having received multiple therapies for the past year and having demonstrated little to no progress according to medical records, the compensatory approach may be most ideal for this patient. However, the results of his present OT evaluation are important and should be heavily considered before determining a plan of care. If the patient has mostly intact cognition, adaptive equipment can be explored along with strategies and environmental modifications to compensate for impaired bilateral coordination.

2. What strategies or adaptive equipment can help this patient with his functional goals?

   Since the patient has deficits in the realm of dressing, he may benefit from a dressing stick, button hook, and zipper pull. In terms of meal preparation, the patient may enjoy using divided or scoop plates and bowls with dycem helping adhere them to the table, an electric can opener or one-handed can opener, a rocker knife, a one-handed cutting board, and one-handed culinary scissors. Therapists can train the patient in the use of any of these tools based on their specific needs.

3. Is this patient able to live alone safely at his current level of functioning?

   The therapist cannot determine this based on the patient's motor skills alone. The OT needs to complete a thorough evaluation including a functional assessment of the patient's cognition.

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