

Indexing Metadata/Description

- › **Title/condition:** Developmental Coordination Disorder (Occupational Therapy)
- › **Synonyms:** Coordination disorder, developmental; childhood coordination disorder; coordination disorder, childhood; motor dyspraxia; clumsy child syndrome; developmental dyspraxia; perceptuomotor dysfunction; disorder of attention and motor perception (DAMP); motor learning difficulty
- › **Anatomical location/body part affected:** Motor function of upper and lower extremities, central nervous system (CNS), musculoskeletal system
- › **Area(s) of specialty:** Pediatric rehabilitation, neurological rehabilitation
- › **Description:** Impaired motor coordination is the hallmark feature of DCD as outlined in the *Diagnostic and Statistical Manual of Mental Disorders (DSM-5)*.⁽¹⁾ In order to give a diagnosis of DCD according to the *DSM-5*, four of the following criteria must be met:
 - Performance in daily activities that require motor coordination is substantially below that expected given the person's chronological age and measured intelligence. This may be manifested by marked delays in achieving gross and/or fine motor milestones, poor handwriting, poor performance in sports, dropping things, or "clumsiness"
 - Criterion 1 deficits significantly and continuously interfere with academic achievement or activities of daily living (ADLs) appropriate to chronological age
 - Onset of symptoms is in the early developmental period
 - Motor skills deficits are not explained by intellectual disability or visual impairment and are not attributable to a neurological condition affecting movement (e.g., cerebral palsy, muscular dystrophy, degenerative disorder). If intellectual disability is present, the motor difficulties are greater than those expected for the mental age
 - Globally, the prevalence of DCD among children is 5-10%^(2,3)
- › **ICD-9 codes**
 - 315 specific delays in development
 - 315.2 other specific developmental learning difficulties
 - 315.4 developmental coordination disorder
 - 315.8 other specified delays in development
 - 315.9 unspecified delay in development
 - 781.3 lack of coordination
 - 783.40 unspecified lack of normal physiological development
 - 783.42 delayed milestones
- › **ICD-10 codes**
 - F82 specific developmental disorder of motor function
- › **G-Codes**
 - **Mobility G-code set**
 - G8978, Mobility: walking & moving around functional limitation, current status, at therapy episode outset and at reporting intervals
 - G8979, Mobility: walking & moving around functional limitation; projected goal status, at therapy episode outset, at reporting intervals, and at discharge or to end reporting

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- G8980, Mobility: walking & moving around functional limitation, discharge status, at discharge from therapy or to end reporting
- **Changing & Maintaining Body Position G-code set**
 - G8981, Changing & maintaining body position functional limitation, current status, at therapy episode outset and at reporting intervals
 - G8982, Changing & maintaining body position functional limitation, projected goal status, at therapy episode outset , at reporting intervals, and at discharge or to end reporting
 - G8983, Changing & maintaining body position functional limitation, discharge status, at discharge from therapy or to end reporting
- **Carrying, Moving & Handling Objects G-code set**
 - G8984, Carrying, moving & handling objects functional limitation, current status, at therapy episode outset and at reporting intervals
 - G8985, Carrying, moving & handling objects functional limitation, projected goal status, at therapy episode outset, at reporting intervals, and at discharge or to end reporting
 - G8986, Carrying, moving & handling objects functional limitation, discharge status, at discharge from therapy or to end reporting
- **Self Care G-code set**
 - G8987, Self care functional limitation, current status, at therapy episode outset and at reporting intervals
 - G8988, Self care functional limitation, projected goal status, at therapy episode outset, at reporting intervals, and at discharge or to end reporting
 - G8989, Self care functional limitation, discharge status, at discharge from therapy or to end reporting
- **Other PT/OT Primary G-code set**
 - G8990, Other physical or occupational primary functional limitation, current status, at therapy episode outset and at reporting intervals
 - G8991, Other physical or occupational primary functional limitation, projected goal status, at therapy episode outset, at reporting intervals, and at discharge or to end reporting
 - G8992, Other physical or occupational primary functional limitation, discharge status, at discharge from therapy or to end reporting
- **Other PT/OT Subsequent G-code set**
 - G8993, Other physical or occupational subsequent functional limitation, current status, at therapy episode outset and at reporting intervals
 - G8994, Other physical or occupational subsequent functional limitation, projected goal status, at therapy episode outset, at reporting intervals, and at discharge or to end reporting
 - G8995, Other physical or occupational subsequent functional limitation, discharge status, at discharge from therapy or to end reporting

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G-code Modifier	Impairment Limitation Restriction
CH	0 percent impaired, limited or restricted
CI	At least 1 percent but less than 20 percent impaired, limited or restricted
CJ	At least 20 percent but less than 40 percent impaired, limited or restricted
CK	At least 40 percent but less than 60 percent impaired, limited or restricted
CL	At least 60 percent but less than 80 percent impaired, limited or restricted
CM	At least 80 percent but less than 100 percent impaired, limited or restricted
CN	100 percent impaired, limited or restricted

Source: <http://www.cms.gov>

- › **Reimbursement:** No specific issues or information regarding reimbursement have been identified; however, children in the United States may qualify for state-funded early intervention programs and/or school-based therapy services
- › **Presentation/signs and symptoms:** Specific manifestations of DCD are varied, and pervasive, and may affect gross motor skills, fine motor skills, academic/learning, and social-emotional skills^(2,3)
 - Delayed gross and fine motor skills commonly reported include reciprocal creeping, walking, talking, self-dressing, ball skills, and handwriting^(2,3)
 - Developmental delays may be mild at an earlier age and become more apparent as affected children enter primary school due to the increased physical, social-emotional, and cognitive demands⁽²⁾
 - Cognitive and behavioral delays may become more apparent as a child ages due to frustration with poor motor skills, low self-esteem, and social isolation⁽²⁾
 - In children, there is a great variability with respect to apparent age of onset and developmental progression; most often DCD does not fully present until school age as a result of a greater need to acquire skills that require adaptations in speed, timing, force, or distance of movement⁽²⁾
 - Children do not outgrow DCD, but physical developmental delays become less apparent as they enter high school because they can limit participation in physical activities⁽²⁾
 - Other signs/symptoms
 - Poor academic performance, poor reading comprehension, poor writing skills^(1,2)
 - Hypotonia⁽⁴⁾
 - Visual perception problems⁽¹⁾
 - Children with DCD are more likely to develop poor self-esteem, academic problems, behavioral problems, difficulty with peer relationships, and difficulties with social competence⁽⁵⁾
 - Withdraw or avoidance of physical activities⁽⁵⁾

Causes, Pathogenesis, & Risk Factors

› Causes

- Etiology is largely unknown
- Sensory deficits associated with DCD may result from dysfunction in CNS processing involved in planning, organizing, and timing of motor responses. Failure to anticipate sensory input cues or use perceptual information for movement may be more related to inadequate or poor CNS processing^(2,5)
- Other possible causes⁽⁶⁾
 - Sensory processing dysfunction
 - Perceptual-motor dysfunction
 - Kinesthetic dysfunction
 - Environmental – how a child interacts with his or her social and physical environment might impact his or her ability to acquire skills
 - Genetic
 - Cognitive – inability to problem-solve motor tasks

› Pathogenesis

- Unknown
- Some theoretical models describe DCD as a disruption in the neurological pathways of motor development⁽⁷⁾
 - The motor cortex, vestibular system, and cerebellum integrate the neural pathways for movement or sequence of movements
 - Proprioceptive input, visual input, and state of arousal provide information to the CNS to coordinate movement
 - If any of these neurological systems are not functioning adequately, slow, unsteady, or clumsy movement can result

› Risk factors

- Premature birth, especially with extremely low birth weight (ELBW) for gestational age^(2,8,9,10)
- Race does not appear to be a risk factor⁽⁷⁾

- High comorbidity rate with attention deficit hyperactivity disorder (ADHD) – co-occurrence rate of 30-50%⁽¹¹⁾
- Affects males 3-4x more often than females⁽²⁵⁾

Overall Contraindications/Precautions

- › See specific **Contraindications/precautions to examination** and **Contraindications/precautions** under Assessment/Plan of Care

Examination

› **Contraindications/precautions to examination**

- A multidisciplinary team assessment may be the best approach when evaluating children with DCD due to the complexity and variability of their functional impairments and activity limitations. The team of rehabilitative therapists may include physical therapists (PTs), occupational therapists (OTs), speech-language pathologists (SLPs), and psychologists/neuropsychologists⁽¹¹⁾
- It is crucial to conduct the initial evaluation in the most minimally threatening manner in hopes of limiting future anxiety and resistance to treatment intervention. Primary caregivers ideally should be present during the evaluation
- Specific developmental assessments are used to determine the presence of DCD, but they should not be used alone to make or rule out the diagnosis. Refer to the patient's primary physician if any abnormal neurological and/or behavioral signs exist or there is parental report of loss of gross/fine motor skills
- Children with DCD do not necessarily report pain; however, respect their need for rest breaks since fatigue is a common symptom⁽²⁾

› **History**

• **History of present illness**

- **Mechanism of injury or etiology of illness:** Inquire about milestones (e.g., sitting unsupported, standing, crawling, walking) and when they were achieved. Children with DCD are often delayed in meeting developmental milestones⁽⁶⁾
- **Course of treatment**
 - **Medical management:** Document physician's orders for other therapies, if any, or medications
 - **Medications for current illness/injury:** Document if any medications are currently prescribed and if they are being taken
 - **Diagnostic tests completed**
 - Psychometric intelligence testing may have been completed⁽¹²⁾
 - Visual and auditory testing may be indicated to rule out any visual or auditory disorders as possible causes of developmental delays⁽²⁾
 - Formal diagnosis is made by a physician when DCD criteria are met as outlined in the *DSM-5*⁽¹⁾ please see *Description*, above
 - **Home remedies/alternative therapies:** Document any use of home remedies or alternative therapies (e.g., vitamins or other supplements) and whether or not they help
 - **Previous therapy:** Document whether patient has had occupational, physical, behavioral, or speech therapy for this or other conditions and what specific treatments were helpful or not helpful. Children may have received therapeutic intervention in the past but were not specifically diagnosed with DCD through early intervention. The majority of children are referred for therapeutic intervention during the early years of primary school, often due to immature and laborious handwriting, difficulty performing ball skills, and difficulty copying from the blackboard⁽²⁾
- **Aggravating/easing factors**
 - Note specific tasks in which DCD is most evident
 - Note any environments, such as school or home, where function is affected
 - Note any specific tasks or environments in which DCD does not appear to be as apparent
- **Nature of symptoms**
 - Document nature of symptoms. Parents often report child being clumsy or awkward, frequently dropping things, easily fatigued, unaware of environment⁽²⁾
 - Observe the fluidity of movement/body positions (i.e., smooth or jerky)⁽⁶⁾
 - Observe if coordination problems occur with sequencing and timing movements⁽⁶⁾

–**Pattern of symptoms**

- Document changes in symptoms throughout the day and night, if any (A.M., mid-day, P.M., night); also document changes in symptoms due to weather or other external variables

–**Sleep disturbance**

- Document number of wakings/night
- Children with DCD are more likely to have sleep disturbances (e.g., parasomnias) and resistance to going to sleep⁽¹³⁾

–**Other symptoms**

- Document other symptoms patient may be experiencing that could exacerbate the condition and/or symptoms that could be indicative of a need to refer to physician

–**Barriers to learning**

- **Are there any barriers to learning? Yes ___ No ___**
- **If Yes, describe _____**

• **Medical history**

–**Past medical history**

- **Comorbid diagnoses:** Document other conditions that are present, such as, attention deficit hyperactivity disorder (ADHD), sensory integration disorder, speech-language disorders, obesity, behavioral difficulties, and dyslexia⁽¹⁴⁾
- DCD may be a precursor of overweight/obesity which increases the risk of diabetes mellitus, type 2 (DM2) and hypertension^(9,11,15)
- In a study conducted in the Netherlands, researchers reviewed the medical charts for a sample of 3,608 children who were patients at rehabilitation centers. In this sample, 20.4% (n=735) of the children had motor problems, including DCD. Researchers found that in the sample of 735 children with motor problems, comorbidities existed in 23.9% to 33.7% of the children; the most commonly occurring comorbidities were speech and language disorders⁽⁴⁵⁾
- **Medications previously prescribed:** Obtain a comprehensive list of medications prescribed and/or being taken (including over-the-counter drugs)
- **Other symptoms:** Ask patient and/or parents about other symptoms he/she may be experiencing. Ask about any mental health history or problems with affect, anxiety, poor self-esteem, poor peer relationships, or perceptions of competence⁽¹⁶⁾

• **Social/occupational history**

–**Patient's goals**

- Document the child's and the parents' goals for therapy
- Use of goal setting improves child's motivation to participate in activities⁽¹⁷⁾
 - **Perceived Efficacy and Goal Setting System (PEGS):** ^(18,19) This assessment measures children's perceptions of their competence. Picture cards of children completing tasks are shown, and children are asked if they are 'a lot' or 'a little' like the children in the picture. This assessment is best used in children under the age of 8 years
 - **Canadian Occupational Performance Measure (COPM):** ^(14,19) This is an interview format assessment in which children/families are asked to rate their current performance and satisfaction with tasks. This is best used with children over 8 years of age

–**Vocation/avocation and associated repetitive behaviors, if any:** Document the child's participation in recreational or competitive sports/activities/hobbies⁽¹⁶⁾

- Children with DCD often have difficulty participating in activities that require greater precision, continuous adaptability, and eye-hand coordination (e.g., throwing, catching, kicking, playing an instrument)⁽²⁰⁾

–**Functional limitations/assistance with ADLs/adaptive equipment**

- Parents often report their child having difficulty performing age-appropriate ADLs such as dressing, feeding, hygiene, and other self-care routines^(2,9)
- How much time does the child spend on his or her self-care, productivity, and play/leisure activities⁽¹⁶⁾
- Does the child avoid certain tasks/activities⁽⁶⁾
- How does the child interact with his/her peers in tasks/activities
- The Developmental Coordination Disorder Questionnaire (DCDQ) is a valid, reliable, parent questionnaire designed to identify subtle motor problems in children aged 5-15 years^(21,22,23,24)

- Pediatric Evaluation of Disability Inventory (PEDI) is a standardized assessment tool measuring functional self-care, social, and mobility activities⁽¹¹⁾
- DCD is a risk factor for poor peer relationships because social life is often limited due to decreased age-appropriate physical activity/play⁽³⁾

–Living environment

- With whom does the patient live (family members, siblings)? Does the child attend day-care or after-school care? If so, how many hours/week?
- Are there any barriers within the home to patient's independence? ⁽¹⁶⁾

› **Relevant tests and measures: (While tests and measures are listed in alphabetical order, sequencing should be appropriate to patient medical condition, functional status, and setting)** The diagnosis of DCD should not be made based on a single standardized assessment or questionnaire, or by a single practitioner.⁽⁴⁹⁾ It is important to utilize both standardized and observational assessment measures and to gather input from several sources (e.g., parents, teachers, therapists) to ensure accurate diagnosis and to deliver appropriate treatment⁽⁴⁹⁾

• **Anthropometric measurements:** Document body mass index (BMI); DCD is associated with increased risk of obesity^(2,11,15)

• **Arousal, attention, cognition (including memory, problem solving)**

- Document memory, both short-term and long-term
- Document attention, level of alertness for therapeutic tasks
- Document learning styles observed
- Child Behavior Checklist (CBCL): 120-item parent questionnaire assessing behavioral and emotional problems in the previous 6 months for children aged 2-18 years
 - Easily administered in order to assess need for psychology referral and assist with treatment intervention

• **Assistive and adaptive devices**

- Document any use of assistive or adaptive devices used for task performance, such as pencil grips or slant boards for writing, special shoe strings/Velcro straps instead of shoe strings

• **Balance**

- Assess for static and dynamic balance in sitting and standing.
 - Poor postural control and balance are two of the most common features (73-87%) of children with DCD⁽²⁵⁾
- Commonly used tests: Bruininks-Oseretsky Test of Motor Proficiency (BOT), Second Edition (BOT-2) balance subscale, Pediatric Balance Scale (PBS), MABC (Movement Assessment Battery for Children) or MABC-2, computerized posturography system

• **Cardiorespiratory function and endurance**

- Document child's tolerance of and endurance in physical activity; children with DCD typically exhibit a lower level of cardiorespiratory fitness than typically developing peers⁽⁴⁸⁾
 - Measure pre- and posttest heart rate (HR) and blood pressure (BP)
 - Assess patient's level of exertion using dyspnea scale and/or Modified Borg Rating of Perceived Exertion (RPE) Scale
- Children with DCD have a higher perceived level of exertion during running activity and difficulty achieving maximal aerobic capacity⁽²⁶⁾
- Increased fatigue compared to peers without DCD is often reported, most likely resulting from decreased strength, inefficient movement patterns, and avoidance of physical activity. Poorer performance is reported in physical fitness tests with high demands on coordination compared to peers; this difference increases with age^(2,9,27,28)

• **Cranial/peripheral nerve integrity:** Perform dermatomal/myotomal testing for upper extremity (UE) and lower extremity (LE) as indicated

• **Ergonomics/body mechanics**

- Observe child's body mechanics during functional tasks

• **Functional mobility (including transfers, etc.)**

- Observe child's ability to transition in/out of positions such as sitting, standing, supine, kneeling

• **Gait/locomotion**

- Observe patterns of walking and running
- Assess patient's gait and note any significant deviations such as toe walking, decreased reciprocal arm swing, decreased speed, extent of falling or loss of balance, etc.

- **Motor function (motor control/tone/learning)**

- Assess child's trunk and extremity muscle tone in functional gross motor activities
- Children with DCD present with trunk and extremity hypotonia⁽⁴⁾
- Note bilateral integration, motor sequencing, and ability to cross midline when assessing age-appropriate skills such as jumping jacks, throwing, kicking, or catching a ball
- The patient may present as stiff, awkward, and clumsy, often resulting from “fixing” joints⁽¹⁸⁾
 - Fixing – holding joint(s) as a means of stabilizing so that another joint can be moved with better control. Used as a way to control for excess degrees of freedom with movement, often resulting in complaints of fatigue and inconsistency with task performance⁽⁴⁾
- Children with DCD have decreased adaptability and flexibility in motor behavior/motor learning, tending to rely on feedback while the movement is occurring (i.e., visual) vs. developing anticipatory responses
 - Children with DCD have delayed reaction time⁽⁴⁾
- Children with DCD often have lack of fluidity of movement and decreased speed while running
- Children with DCD may have excessive grip force for holding an object⁽²⁹⁾

- **Muscle strength**

- Perform manual muscle testing (MMT) in older children
- Observe muscle strength during functional tasks such as climbing, pushing, and pulling in younger children

- **Neuromotor development:** Use an assessment tool such as the M-ABC-2, Assessment of Motor Coordination and Dexterity (AMCD), Peabody Developmental Motor Scales, Second Edition (PDMS-2), PEDI, or Performance Quality Rating Scale (PQRS):

- M-ABC-2
 - This standardized test assesses for motor impairment in children
 - Children scoring below the 5th percentile are defined as having a motor impairment⁽¹²⁾
 - Children scoring in the 6th-15th percentiles are deemed to have borderline difficulties with motor coordination. The M-ABC-2 tends to identify more children with DCD than the BOT-2⁽¹⁴⁾
 - The BOT-2 assesses gross and fine motor skill development. It is most frequently used with school-aged children. It also contains qualitative descriptors of movement and a behavioral and environmental checklist
 - 4 subtests (manual dexterity, ball skills, static balance, dynamic balance) that indicate overall motor impairment^(9,15)
 - Normative test with good reliability and concurrent validity
 - Subtle postural control problems may be missed; more specific balance/postural control tests may be indicated⁽¹⁵⁾
 - May penalize children with learning and attention problems^(9,11,15)
 - Was shown to be a reliable and valid measure of motor competence in children with DCD in a study of 144 Taiwanese children with DCD⁽³⁰⁾
- AMCD:⁽¹⁸⁾ This assessment focuses on motor abilities through observation of strength, balance, coordination, sensory discrimination, visual perception, and observation of school performance of motor tasks. It has good interrater reliability for bilateral coordination and motor sequencing skills
- PDMS-2:⁽¹⁴⁾ This standardized assessment measures gross and fine motor skills of children from birth to 6 years of age
 - Common difficult gross motor activities: running, jumping, hopping, skipping, throwing-catching⁽²⁾
 - Common difficult fine motor activities: handwriting, managing fasteners (buttons, zippers, clasps), tying shoes⁽²⁾
- PQRS:⁽¹⁷⁾ This assessment rates the quality of a child's performance on a specific occupational performance goal
- Vineland Adaptive Behavior Scale, Second Edition (VABS-II):⁽¹⁹⁾ This assessment observes motor performance in functional, everyday tasks

- **Perception** (e.g., visual field, spatial relations)

- Assess visual motor integration, visual perceptual assessment through standardized tests such as:
 - Test of Visual Perceptual Skills (TVPS)
 - Developmental Test of Visual Motor Integration (VMI)
 - Motor-Free Test of Visual Perception (MTVP)

- **Posture**

- Note postural stability in sitting and standing

–Some children with DCD are reported to fall frequently or have trouble copying body positions due to reduced motor planning and balance issues⁽⁴⁾

- **Range of motion**

- Assess range of motion (ROM) of UEs and LEs, noting any asymmetry or limitation

- **Self-care/activities of daily living** (objective testing)

- Observe child’s participation, quality of movement, and motor planning in ADLs

- Common ADLs requiring eye-hand coordination are often impaired: dressing, feeding, and hygiene, handwriting, and cutting; referral to OT is warranted^(2,9)

- **Sensory testing**

- Assess sensory discrimination including two point discrimination, stereognosis, and light touch for UEs and LEs⁽²⁹⁾

- **Special tests specific to diagnosis**

- The Sensory Profile Survey should be filled out by parents if sensory processing disorder is suspected⁽³¹⁾

- The Developmental Coordination Disorder Questionnaire (DCDQ)⁽³²⁾

- Parent questionnaire regarding the child’s (ages 5-15) functional skills and parent’s perception of how child functions in comparison to other students and in different environments

- The DCDQ correlates highly with the M-ABC-2

- Valid and reliable clinical screening tool for children with DCD

- Some studies indicate the DCDQ is better at identifying moderate to severe DCD vs. mild DCD

- Recommended as an adjunct to standardized tests to rule out motor delays

- The DCDQ has been shown to be valid and reliable; however, an Australian study found that the M-ABC-2 and the DCDQ were only modestly effective in accurately diagnosing children with DCD, with a high rate of false positives and false negatives using the recommended cutoffs for each test⁽²²⁾

- Research indicates that the overall agreement among the BOT-2, M-ABC-2, and DCDQ was < 80%, indicating the need for clinical reasoning in conjunction with standardized tests when examining children’s motor abilities. The M-ABC-2 and DCDQ assess if there are motor problems, and the BOT-2 assesses motor skills, therefore potentially identifying different children with motor deficiencies⁽²¹⁾

- School Function Assessment (SFA):^(14,19) This measures a child’s participation in school-related settings, the amount of assistance or adaptation he or she needs for school activities, and the performance of these activities. This is an interview and observation assessment

- Adolescents and Adults Coordination Questionnaire (AAC-Q): A self-report questionnaire used to identify DCD in adolescents and adults; it is a standardized, reliable, and valid tool for both research and clinical use^(33,46)

Assessment/Plan of Care

- › **Contraindications/precautions**

- **Patients with this diagnosis are at risk for falls due to decreased balance and postural control; follow facility protocols for fall prevention and post fall prevention instructions at bedside, if inpatient. Ensure that patient and family/caregivers are aware of the potential for falls and educated about fall prevention strategies. Discharge criteria should include independence with fall prevention strategies**

- Clinicians should follow the guidelines of their clinic/hospital and what is ordered by the patient’s physician

- The summary below is meant to serve as a guide, not to replace orders from a physician or a clinic’s specific protocols

- It is extremely important to be in direct communication with the referring physician, primary caregivers, and other rehabilitation staff regarding the patient’s course of treatment

- › **Diagnosis/need for treatment**

- Early diagnosis, treatment, and educational support are extremely important to addressing the needs of children with DCD; the ideal time for diagnosis is prior to entering kindergarten through the early primary school years

- Developmental questionnaires and screens are useful tools that parents, teachers, and primary care providers can use to assist in making the proper diagnosis⁽¹⁾

- › **Rule out**

- DCD should only be diagnosed once an underlying musculoskeletal/neurological disorder has been excluded as the cause of the child’s developmental delays⁽²⁾

- Cerebral palsy^(1,9)
- Autism spectrum disorder (ASD)⁽¹²⁾
- ADHD
- Brain tumor, epilepsy, Friedreich's ataxia, and Ehlers-Danlos syndrome^(2,9)

› **Prognosis**

- Research indicates that children with DCD will avoid physical activity (sports or leisure), which reduces their opportunities for social interaction and decreases physical fitness throughout life, placing them at risk for developing DM2 and cardiovascular disease
- Children do not outgrow DCD, but physical developmental delays become less apparent as they enter high school because they can limit participation in physical activities⁽³⁾
- Coordination and motor difficulties can persist into adulthood⁽¹⁷⁾
- Children with DCD have a higher incidence of learning disabilities and ADHD⁽¹⁷⁾
- Failure to diagnose DCD and provide therapeutic intervention can result in major difficulties throughout childhood and into adulthood, including unemployment, psychiatric disorders, substance abuse, poor interpersonal skills, and criminality. The more severe the condition, the greater the chance of problems persisting into adulthood^(2,9)

› **Referral to other disciplines**

- Physical therapy for gross motor skills, strengthening, endurance, and coordination; for information about physical therapy for DCD, see *Clinical Review...Developmental Coordination Disorder (Physical Therapy)*; Item Number:T708987
- Neuropsychology for possible cognitive testing
- Vision therapy for any vision-related concerns
- Psychologist/social worker for emotional and behavioral support
- Speech therapy for speech/language problems
- Behavior therapy for behavioral impairments

› **Treatment summary**

- There are two ways to approach treatment of DCD: bottom up (treating underlying deficits in areas such as sensory integration or perceptual motor) and top down (cognitive approaches to learning motor skills)
- Sensory integrative treatment consists of using controlled sensory input and adaptive motor responses. It promotes motor development and higher cortical learning⁽⁶⁾
- Authors of a review of literature from 1984 to 2011 that included 19 articles that considered six categories of intervention for children with DCD (Cognitive Orientation to daily Occupational Performance [CO-OP], sensory integration, neuromotor task training, goal-oriented group interventions, exercise programs, and compensatory strategies) found that CO-OP was the most effective for improving occupational performance in children with DCD⁽⁴⁷⁾
- CO-OP is a cognitive, problem-solving approach to motor acquisition
 - The goal is for child to learn new motor skills, use the appropriate cognitive strategies for these skills, and generalize the skills across different tasks and environments^(17,34)
 - Use of the CO-OP program may improve occupational performance in children with DCD^(17,35)
 - Based on research study of 20 children with DCD who participated in CO-OP
- Children who participate in CO-OP may use better cognitive strategies for motor skills than those who are treated with a neurodevelopmental, sensory integrative, or functional approach⁽⁶⁾
 - Based on a research study conducted in the United Kingdom involving 18 children aged 7-11 years who participated in 10 sessions of either the CO-OP program or a sensory integrative, neurodevelopmental, or functional approach to motor acquisition
 - Children watched a tape of a child having trouble skipping rope and were asked two questions to see if they could evaluate the problem and identify strategies. These were asked both before and after treatment
 - Children who participated in CO-OP program could generate significantly more cognitive strategies
- Participation in a therapy group can have positive effects on self-esteem in children with DCD⁽³⁶⁾
 - Based on a research study conducted in the United Kingdom involving 12 children with DCD who participated in one group session per week for 6-8 weeks. Each session was 1 to 1.5 hours long
 - Sessions consisted of mainly motor-based group activities, such as hockey or volleyball

- Neuromotor task training (NTT) can improve handwriting and fine and gross motor skill development in children with DCD⁽⁵⁾
 - Dutch researchers conducted a pilot study to assess the effectiveness of NTT in children with DCD compared to a control group⁽³⁷⁾
 - PTs proficient in NTT provided individual direct physical therapy for 30 minutes once a week for 18 weeks. Children who received NTT improved in both gross and fine motor skills as measured by the M-ABC-2 after the 18 treatment sessions
 - Despite balance skills not being directly practiced, this area improved on the M-ABC-2, most likely due to the fact that postural control was indirectly treated when performing many of the other motor skills
- Activity analysis (breaking down activity into component tasks) can help to identify activities appropriate for the child’s skill level and with the appropriate benefits for motor coordination⁽⁵⁾
- Educating parents to participate in treatment interventions with children with DCD can also be a valuable treatment strategy⁽⁵⁾
- Virtual reality (VR) rehabilitation (use of hardware and software to simulate situations/environments) may be a safe and feasible intervention for children with sensorimotor deficits since it allows children to engage in play, and provides opportunity to practice skill acquisition⁽³⁸⁾
 - Based on a systematic review of the literature, 17/26 studies noted a positive effect of VR rehabilitation, although many studies were poorly designed
 - One randomized controlled trial demonstrated statistically significant improvement in group receiving VR rehabilitation
 - Several studies indicated that VR technology could be effectively applied for the training of perceptual skills
 - More rigorous research design and methodology is needed to study the effects of VR rehabilitation
- A goal-oriented group occupational therapy intervention for children with DCD that occurs eight times over a 2-week period may improve coordination and function⁽³⁹⁾
 - Based on an abstract of a pilot study conducted in the United Kingdom of effectiveness of occupational therapy interventions for children with DCD
 - 22/30 goals were met when children participated in a goal-oriented group 8 times over 2 weeks
 - There was also a significant increase in coordination scores on the M-ABC-2
 - In a study involving 8 children aged 7-11 years with DCD in the United Kingdom, children set goals with parent/caregiver input⁽⁴⁰⁾
 - Children participated in eight 50-minute sessions over 2 weeks
 - Sessions were goal oriented, combining motor learning and cognitive strategies
 - There were significant improvements in COPM and M-ABC-2 scores following goal-oriented group intervention

Problem	Goal	Intervention	Expected Progression	Home Program
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<p>Poor motor skill acquisition</p>	<p>Improve motor planning and participation in daily activities</p>	<p><u>Cognitive approaches</u> (34)</p> <p>Goal-Plan-Do-Check strategy</p> <p>Help child to identify the goal, provide a plan for how to meet the goal, execute his or her plan, and monitor his or her performance</p> <p>Cognitive Orientation to daily Occupational Performance (CO-OP) strategy⁽⁶⁾</p> <p>Use of self-talk, problem solving to learn global cognitive strategies and also domain specific strategies for tasks</p> <p><u>Functional training</u></p> <p>Task-specific intervention^(4,19)</p> <p>Direct teaching of a skill, such as riding a bike, throwing a ball. Tasks broken down into steps and taught individually</p> <p>Create practice opportunities in different environments to allow for problem solving</p> <p>Handling, positioning, verbal instructions, visual and observational learning, modeling techniques by therapist can be used to teach skills</p>	<p>Progress motor activity/ task from simple to multistep tasks as the child learns motor skills</p> <p>Provide less verbal cues and guidance as child develops his or her own cognitive strategies for motor tasks</p>	<p>Provide patient with opportunity to practice and verbalize new skills</p> <p>Incorporate learning strategies to activities at home and school</p>
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<p>Poor sensory integration and perceptual motor function</p>	<p>Improve sensory processing</p>	<p><u>Therapeutic activities</u></p> <p>Sensory integrative therapy:⁽⁶⁾ Provide various sensory input, proprioceptive, tactile, vestibular to allow child to develop motor skills through sensory integration</p> <p>Perceptual motor therapy⁽⁶⁾: Provide a range of motor experiences and opportunity to practice skills</p>	<p>Progress sensory input as child tolerates, integrating sensory input with motor activities</p>	<p>Home movement program/sensory diet daily to encourage obtaining sensory input and organization</p>
<p>Decreased kinesthetic awareness</p>	<p>Improve kinesthetic awareness</p>	<p><u>Therapeutic activities</u></p> <p>Process-oriented treatment⁽⁴⁾</p>	<p>Adapt activities to the abilities of the child and progress the level of difficulty</p>	<p>Home movement program daily to encourage obtaining kinesthetic and proprioceptive input</p>

<p>Decreased participation in occupational performance (self-care, academics)</p>	<p>Improve participation in occupational performance</p>	<p>Functional training (41)</p> <p>Task-specific intervention</p> <p>Create opportunities to practice skills</p> <p>Use various techniques such as handling, modeling, verbal guidance to teach performance of functional tasks⁽¹⁹⁾</p> <p>Provide appropriate feedback for performance of tasks⁽¹⁹⁾</p> <p>Task modification and activity analysis to match activity to patient ability</p>	<p>Provide less feedback and cueing as the child learns new skills</p>	<p>Provide opportunities to practice new skills</p>
<p>Decreased participation in fitness activities</p>	<p>Increase participation in fitness activities</p>	<p>Functional training</p> <p>Education about benefits of physical fitness⁽¹⁶⁾</p> <p>Identify strengths of child and match them to his or her environment and activities⁽¹⁶⁾</p> <p>Advocate for unstructured, noncompetitive play in school environment⁽¹⁶⁾</p>	<p>N/A</p>	<p>Participation in appropriate leisure activities in the community</p>

Decreased self-esteem	Increase self-esteem	Group therapy ⁽³⁶⁾ Participation in group motor-based activities to encourage success in motor tasks and gain peer support	N/A	N/A
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Desired Outcomes/Outcome Measures

- › Desired outcomes
 - Participation in occupational performance activities appropriate to the child's age
 - Use of appropriate cognitive learning and problem-solving strategies for motor skill learning
 - Improved academic performance
- › Outcome measures
 - COPM
 - M-ABC-2
 - BOT-2
 - PDMS-2
 - DCDQ
 - PBS
 - PEDI
 - VABS-II
 - Sensory Profile Survey

Maintenance/Prevention

- › Therapists need to educate primary care physicians, teachers, and parents in their communities about DCD so that children with DCD can receive therapeutic intervention in order to ameliorate potential difficulties that can arise in the school setting. Early intervention is more likely to improve coordination and motor skills in children with DCD, which will have a positive effect on their self-esteem and socialization⁽²⁾
- › Continued maintenance of motor skill acquisition through opportunities for practice at home and school using strategies identified by child and therapist
- › Actively encourage participation in appropriate leisure activities that emphasize physical fitness and motor skills that the individual child can perform successfully in order to maintain muscle strength, power, and endurance while promoting a positive social and psychosocial environment
- › Physical activity is directly linked with peer acceptance in childhood and adolescence, which affects self-esteem and ability to make friends⁽²²⁾
- › Finding physical activities that a child is interested in and can be successful at will promote a more healthy lifestyle and potentially minimize the risk of obesity and cardiovascular disease^(9,42,43,44)

Patient Education

- › Canchild Centre for Childhood Disability Research in Canada, www.canchild.ca
- › General information on DCD and dyspraxia, <http://www.dystalk.com/talks/56-what-is-dyspraxia>
- › European Academy of Childhood Disability Guidelines for diagnosis and treatment of DCD, <http://www.eacd.org/publications.php>

Coding Matrix

References are rated using the following codes, listed in order of strength:

M Published meta-analysis	RV Published review of the literature	PP Policies, procedures, protocols
SR Published systematic or integrative literature review	RU Published research utilization report	X Practice exemplars, stories, opinions
RCT Published research (randomized controlled trial)	QI Published quality improvement report	GI General or background information/texts/reports
R Published research (not randomized controlled trial)	L Legislation	U Unpublished research, reviews, poster presentations or other such materials
C Case histories, case studies	PGR Published government report	CP Conference proceedings, abstracts, presentation
G Published guidelines	PFR Published funded report	

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