

What is Developmental Coordination Disorder?

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“I am not clumsy, I’m just accident prone”
-Daniel Radcliffe



MEDBRIDGE

Have you ever worked with a child who could not just figure out how to kick a ball, hold a pencil, or put their coat on?

Objectives

- Be able to explain the diagnostic criteria for DCD
- Discuss the etiology/neuropathophysiology of DCD
- Differentiate DCD from other common childhood motor impairments
- Describe the common characteristics of children diagnosed with DCD

Definition

- Chronic and usually permanent condition
- Performance in daily activities that require motor coordination is substantially below that expected given the person's chronological age and **measured intelligence**
 - If Cognitive Impairment present motor skills must be below of those usually associated with CI
- History of late motor milestone development
- No evident or diagnosable neurological defect
- Disturbance in motor coordination not due to general medical condition and does not meet criteria for pervasive developmental disorder
- Score 2 SD below the mean on standardized motor tests + problems with academic performance and ADL (WHO, 1993)

Dewey & Wilson, 2001; Geruze et al, 2001; Miyahara & Mobs, 1995; Kirby & Sugden, 2010; Missiuna et al, 2006

Diagnostic Criteria

A. Performance in daily activities requiring motor coordination is substantially below that expected given child's chronological age and measured by intelligence

- Marked delays in achieving motor milestones
- Dropping things
- Clumsiness
- Poor sports performance
- Poor handwriting

DSM-IV-TR

DX Criteria

B. Disturbance in Criteria A significantly interferes with academic achievement or ADLs

C. Disturbance not due to a general medical condition and does not meet the criteria for pervasive developmental disorder

D. If cognitive impairments are present, the motor difficulties are in excess of those usually associated with that impairment

Chapter 2

Pathology of DCD

Prevalance

- About 6% -13% of ordinary children¹
- More males than females: 2:1²
 - **On Average one child in every primary school class is affected³**
- Usually ID between 6 and 12 years old
- Higher incidence in children with history of prenatal or perinatal risks⁴
- ICD 10-CM Diagnostic Code: F82
 - Specific developmental disorder of motor function
 - ICD-9: 315.4 developmental coordination disorder

1. Smyth, 1992; Ploatajko, 1995; DSM-IV, Smits-Engelsman, 2013; Vaivre-Douret, 2014

2. Sugden & Chambers, 1998

3. Missiuna et al, 2006

4. Miyahara & Mobs, 1995

Functional Difficulties from Impairments in 3 Areas

- Poor Postural Control
- Difficulty in motor learning
- Poor Sensorimotor Coordination

Etiology

- Heterogeneous
- Co-existing with other developmental disorders
- Neuropathology has to be hypothesized from behavioral data

Etiology

- Part of the continuum of CP¹
- Aspect of MBD²
- Low end of normal variance in motor ability³
- Related to pre, peri, or post natal risk factors
- Neuronal dysfunction at the cellular level – possible problems in neurotransmitter or receptor systems⁴
- Underactivation of cerebellum⁵
- Altered axonal microstructure in sensory and motor pathways⁵

1. Dare & Gordon, 1970)

2. Dunn, 1986

3. Hall, 1988

4. Hadders-Algra, 2001

5. Zwicker et al 2012

Etiology: Sub-cortical

- Cerebellum
 - Control of tone
 - Balance/Posture
 - Regulation of walking
 - Precision
 - Timing of movements
- Thalamus & Basal Ganglia
 - Thalamus
 - Relay for all sensory pathways
 - Basal Ganglia
 - Preparing/starting movement
 - Suppressing undesired movements

Vaiver-Douret

Etiology: Parietal Lobe

- Poor visual spatial processing
- Adolescents with ADHD and DCD had lower regional cerebral blood flow in the parietal lobe & frontal lobe
 - Less parietal activation during visuomotor tasks

Zwicker et al, 2009

Relationship with ELBW?

- Prevalence of motor impairment in children age 5 yo who were born with ELBW (<1000 gr) was (n = 103):
- 64% demonstrated motor impairment on M-ABC-2
- 26% demo on DCD questionnaire
- DX of DCD at 5 years old = 66%
- Risk factors associated with increased motor impairment
 - Male gender
 - Postnatal steroids
 - Increasing gestational age

Dewey et al, 2011

Chapter 3

Characteristics of the Child with DCD

Sub-Types

Ideomotor Dyspraxia (IM)	Visual Spatial/constructional dyspraxia (VSC)	Mix Dyspraxia (MX)
Digital praxis Imitation of gestures Digital gnosis Crawling Postural control of dynamic balance (60%) Body spatial integration Handwriting Hypotonia Standing Tone <i>Most alike</i> <i>Impaired on fewer tasks</i>	Visual motor integration Visual spatial skills Puzzles Handwriting Arithmetic Vertical visual pursuits Few or no gross motor disorders	Includes a both IM and VSC Motor coordination problems Neuropsychological co-morbidities Bimanual dexterity

Vaivre-Douret et al 2011, 2014; Lalanne et al 2012

Problem

- May appear inattentive due to difficulty stabilizing their bodies and joints
 - They look restless – so frequently viewed as behavior problems in class
- Contribution of motor difficulties to academic and social problems are overlooked
- Heterogeneity – no typical child with DCD –wide range/variety of motor impairments are there subtypes of DCD?
 - Some children have poor fine motor, some have poor gross motor, some have both

Macnab et al, 2001; Smyth, 1992; Missiuna et al, 2006

Problem: Overlap with Other Disorders

- ADHD: 41%¹
- Learning Disabilities – 56%²

1. Dewey & Wilson, 2001; Rasmussen & Gilbert, 2000; Smits-Englesman et al 2013

2. Dewey & Wilson, 2001

Difference DCD and Apraxia

- Apraxia:
 - Acquired disorder
 - Leads to loss in ability to accomplish previously learned skills
- DCD (developmental dyspraxia)
 - Developmental disorder
 - Impairment in learning or performing non-habitual motor tasks
 - Failure to acquire ability to perform age appropriate complex motor skills or voluntary motor activities

Difference DCD and Pervasive Developmental Disorder

- Severe deficits in social interaction, communication
- Stereotypical behavior, interests, and activities



Geuze, 2001

Characteristics

- Immature movement patterns
- Joint laxity, poor trunk extension
- Balance problems
- Problems imitating body positions following two or three step motor commands
- Awkward running and jumping
- Frequently falling and/or dropping things
- Socially immature
- Neurologic soft signs
- Intelligence learning disabilities
- Emotional problems/school problems
- Poor performance in sports

Dewey & Wilson, 2001; Geuze et al, 2001; Polatajko et al 1995; Smyth, 1992

Additional Characteristics

- Tend to adopt more passive interests – avoid activities that expose their weaknesses
- May have decreased muscle strength – primary or secondary impairment?
- Emotional problems/school problems – secondary to motor problems?
- Lack of adaptability and flexibility in motor behavior¹
- Rely on vision for feedback¹
- Fatigue more easily²
- Risk for obesity³
- Poor cardiorespiratory fitness³
 - There is an association with cardiorespiratory fitness at age 18-30 yo and emergence of cardiovascular disease 15 years later
 - DCD – secondary to inactivity?

1. Missiuna et al, 2003

2. Chen et al, 2011

3. Cairney, et al, 2005

Additional Characteristics

- **Children do not outgrow clumsiness!**
 - Impact of DCD continues into adulthood

Chambers, 1988; Schoemaker et al, 1994; Smyth, 1992; Losse et al, 1991; Lirby & Sugden, 2010)

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