

## **Developmental Co-ordination Disorder (DCD)?**

Developmental Coordination Disorder (DCD) is not a new condition. Over the years, different terms have been used to describe children with a predominant picture of motor difficulties. In 1925, Dupre referred to the *debilite motrice* (motorically deficient). Clumsiness has been seen to be a more pejorative term, and was first used by Orton (1937) to describe a group of children with motor difficulties. Pioneering studies started to make their mark in the 1960s (Walton et al, 1962). In 1962, the first article on clumsy children appeared in the *British Medical Journal* (no author cited) and referred to an earlier paper in the 1940s by Annell who had described the clumsy child as being:

*“... awkward in movements, poor at games, hopeless in dancing and gymnastics, a bad writer and defective in concentration. He is inattentive, cannot sit still, leaves his shoelaces untied, does buttons wrongly, bumps into furniture, breaks glassware, slips off his chair, kicks his legs against the desk, and perhaps reads badly.”*

Today, Dyspraxia is the term often used interchangeably in the U.K. with DCD, causing some confusion and inconsistency in terminology. However, DCD is the most recent, formal and widely internationally used term to describe these individuals. It appears in both the Diagnostic and Statistical Manual for Mental Disorders (American Psychological Association, APA, 1994; 2000) and the International Classification of Diseases and Related Health Problems (World Health Organization, WHO, 1992; 1993).

DCD is defined on the basis of a failure of the acquisition of both fine and gross motor skills, which is not explicable on the basis of impaired general learning and similar exposure to opportunity to gain motor skills as their peers. DCD is often seen as the ‘Cinderella’ of developmental disorders and not always considered routinely by clinicians (Kirby et al, 2007). However, there is extensive evidence that motor difficulties have a pervasive effect on children’s lives. The difficulties affect the child both in school and at home, and in contrast with similar aged children who acquire skills with little effort such as dressing, playing ball games and handwriting, these children take longer to learn and automate motor skills.

Increasing interest in these children, in academic research and in clinical and educational practice, has focused on the need not only for early identification but also to consider the presentation in adolescence and adulthood, as around 70% of children continue to have difficulties when grown up (Kirby et al, 2008).

## **PREVALENCE**

There have been wide discrepancies in the prevalence of this disorder and much of this has been due to the use of different assessment methods. Two studies using precise measures are contributing to the narrowing of prevalence range. Wright and Sugden (1996) advocated a two-step approach to assessment using the Movement Assessment Battery for Children (Movement ABC-2, Henderson & Sugden, 2007) as the standardized measure for motor impairment and the Movement ABC Checklist as a guide to examining the effects of motor difficulties on daily living. Using this

methodology, they found that the prevalence figure was 4-5% in mainstream primary schools. More recently, the large U.K. based population study, the Avon Longitudinal Study of Parents and Children (ALSPAC) has shown a prevalence of 1.7% with a further 3.2% of children considered as having "probable Developmental Coordination Disorder" in the case of broader cut-offs for coordination testing and activities of daily living (Lingam et al, 2009).

Gender differences have been examined on numerous occasions, with the consensus being that the condition is more prevalent in boys than girls, with estimates ranging from a small gender difference to three or four to one. However numbers identified may be related to a gender bias in the assessment tools used (Lefebvre and Reid, 1998). Teacher perception of skills among boys and girls may also influence identification (Rivard et al, 2007).

## **POSSIBLE CAUSES**

### *Brain abnormalities*

There has been a resurgence of interest in recent years regarding the underlying aetiology of DCD. One of the first studies by Querne et al (2008) using functional magnetic resonance imaging has shown increased activity in particular areas of the left hemisphere of the brain, particularly in the middle frontal cortex (MFC) and anterior cingulate cortex (ACC) to the inferior parietal cortex (IPC). Decreased activity between the striatum and parietal cortex in the right hemisphere was also evident. The authors suggest that DCD could be characterized by abnormal brain hemispheric specialization during development.

### *Genetic influences*

A twin study undertaken in Australia by Martin et al (2006) showed a strong additive genetic component between subtypes of Attention Deficit Hyperactivity Disorder (ADHD) inattentive subtype and DCD (fine motor). However, as in ADHD and other developmental disorders, a single phenotype is highly improbable and any gene identified will vary in its penetration.

### *Multiple influences*

Morton's (2004) causal modelling approach considering biological, cognitive and behavioural levels may be a good conceptual framework to use when undertaking research and attempting to gain a greater understanding of the field. He presents examples of various developmental disorders such as ADHD, Autistic Spectrum Disorders (ASD) and DCD showing how a possible biological origin moves through cognitive processes to produce the behaviours that are identified.

### *Diet*

There has been some interest in the relationship between Omega 3 fatty acids and DCD. However so far there has been no clear evidence of an association between improved co-ordination with supplementation, nor of lower levels being associated with poorer co-ordination (See Kirby et al, 2009 for review of current research).

Interestingly, antenatal maternal nutrition may influence motor outcomes in the child (Hibbeln et al, 2007).

## **DIAGNOSIS AND ASSESSMENT**

The American Psychiatric Association (APA) and the World Health Organization (WHO) both have inclusive and exclusive criteria in their definitions. For APA the inclusive criteria include: impairment in the development of motor coordination, which can be manifested in delays in milestones such as standing and walking; poor performance in sports activities; and untidy handwriting. This impairment leads to a disturbance in academic performance and/or activities of daily living. Exclusive criteria include the disturbance not being due to a general medical difficulty such as cerebral palsy or a pervasive developmental disorder. In addition, if mental retardation (learning difficulty) is present the motor difficulties are in excess of those usually associated with it.

The WHO (1993) definition overlaps with the APA definition (2000) by noting that, on a standardized test of motor impairment, a child would score two standard deviations below the mean accompanied by interference with academic performance and/or activities of daily living. It notes that there should be no diagnosable neurological disorder and excludes those with an IQ below 70. The WHO recommendation that individuals with an IQ of 70 and below are excluded from the formal definition is one that would be agreed by most clinicians and researchers.

Despite the guidance provided by the APA and WHO, there are still a number of issues surrounding the identification and definitions such as cut off points for diagnosis, who undertakes the assessment, and what type of instruments are used.

Children with DCD are assessed in a variety of ways, but currently there is no appropriate gold standard assessment instrument. In the U.K. the Movement ABC-2 (Henderson & Sugden, 2007) is the most widely used instrument, and contains a standardized normative referenced test, plus a criterion referenced checklist. However, other instruments such as Bruininks-Oseretsky-2 test of motor proficiency (Bruininks & Bruininks, 2005) are also commonly used. There are also a range of screening instruments available for use in clinical practice for example: the Early Years Movement Checklist for 3-5 year olds (Chambers & Sugden, 2006); DCDQ-2 for school age children (Wilson et al, 2009) and Adult DCD Checklist (ADC) for the 16 plus age range (Kirby et al, in press).

An assessment of DCD must include a developmental history in order to identify any developmental delay, especially in motor and language domains (Missiuna et al, 2002). The need for a neurological examination is also essential to exclude children with other neurological conditions such as cerebral palsy, and muscular dystrophy. Additionally, one needs to consider the presence of common genetic conditions where co-ordination difficulties are commonly seen such as Fragile X and Neurofibromatosis type 1. Other associated conditions such as BECTS syndrome (Scabar et al, 2006) and Joint Hypermobility Syndrome (Kirby & Davies, 2007) have been associated with DCD. Checking for common comorbid or overlapping conditions is essential, including ADHD, speech and language impairment, Dyslexia

and ASD as these may impact on educational support and type of intervention approaches undertaken.

***Key areas of difficulties for children and adolescents with DCD are:***

**At home:** difficulties with self care such as dressing, eating. Slower learning to ride a bike.

**At school:** ball skills especially in team games, handwriting difficulties, changing for games, copying from the board.

***Common associated difficulties:***

Poor executive functioning including organization of self and possessions, time management, e.g. losing items, late with assignments, difficulty packing a bag.

Low self esteem, difficulty in making and maintaining friendships, potentially associated with lack of opportunity and practice.

Weight gain.

## **COMORBIDITY**

Green et al (2002) highlighted the widespread prevalence of motor impairment in developmental disorders. The so-called 'pure' DCD with only motor difficulties is the exception rather than the rule (Peters & Henderson, 2008). When viewing DCD, alongside other developmental disorders, it should be viewed as a dimensional concept not a categorical concept as individuals appear to feature on a continuum of disorder. Extensive evidence from a number of researchers has shown high levels of overlap of DCD with other developmental disorders including ADHD, Dyslexia and ASD (Pitcher et al, 2003; Rasta and Eliot, 1999; Kaplan et al, 1997). Additional examples of this include: reading, attention and motor deficits (Kooistra et al, 2005); social and emotional and behaviour, anxiety, and depression (Sigurdsson et al, 2002); speech and language impairment (Hill, 1998); and social and communication impairment (Taylor et al, 2004).

## **PERSISTENCE AND IMPACT**

There was a view until the early 1990s that children with DCD 'grew out' of the condition. Hall (1988) discussed in an article the need to look at the cause for clumsiness as related to 'motivation and good teaching' and referred to extrinsic factors affecting the young person. He stated, 'motor difficulties seem to resolve in the teen years, though they may re-emerge under stress of learning a new motor skill.'

*“... we do our patients no service by treating clumsiness as if it was a disease. With only rare exceptions clumsiness is a talent deficit and like other learning disabilities is primarily an educational problem.” (p 376)*

The need to move away from a narrower medical model to a wider bio-psychosocial model is essential when considering a longer-term view of the disorder.

The effect of having a diagnosis of DCD is not limited to motor functioning and studies in DCD have shown that children perceive themselves as less competent than their peers, not only in the domain of physical play (athletic competence), but also in several other domains including physical appearance and social acceptance (Skinner and Piek, 2001). Adolescents with DCD have also been shown to have psychiatric symptoms ranging from mood and anxiety disorders to social negativism and withdrawal (Sigurdsson et al, 2002). Recent research has also focused on the physical impact, increasing the risk of obesity associated with DCD, especially in boys (Cairney et al, 2005) and also of cardiovascular disease (Faught et al, 2005).

While the impact of DCD has been acknowledged as continuing into adulthood, the knowledge and understanding of symptoms and intervention approaches for this disorder comes mainly from studies in children. Understanding of the pattern of presentation in adults with DCD and the impact this has on individual's lives remains limited (Kirby et al, 2008) and is a focus for future research.

## **INTERVENTION**

In general, the research on progression in children with DCD concludes that, without intervention, the majority of children do not outgrow the condition. However, the research base on intervention in DCD is not nearly as comprehensive as in other developmental disorders such as dyslexia, ADHD and autism spectrum disorder, highlighting the need for longitudinal studies in this field of work. There is a body of literature that can point to success in intervention (Polatajko & Cantin, 2005; Sugden, 2007 for a review). So far, there have been two major approaches to intervention, under different labels, but often referred to as either process-oriented or task-oriented approaches.

Process-oriented are broad-based, usually administered by health professionals (e.g. occupational therapists or physiotherapists), and include such methods as sensory integration therapy. They aim at pinpointing the underlying process or processes in which the child has not developed appropriately and which are thought necessary for successful performance and acquisition of motor skills. Thus, the intervention, for example, would aim to improve the child's kinaesthetic functioning with the aim of this transferring to the functioning of several motor skills.

Task-oriented approaches use a range of cognitive methods but concentrate on the tasks themselves, and success using this approach has been achieved with a range of children. The basis of these approaches is the interaction between the child's resources, the task to be learned and the context in which it is set. The task, often determined through consultation with parents and the child, is taught directly, sometimes broken down into component parts.

In a meta-analysis of the different approaches, the task-oriented approaches have currently emerged as being more successful and should be implemented by paediatricians running children's services (Pless & Carlsson, 2000).

So far, unlike ADHD, medication has not been indicated for usage in children with DCD. However, Tucha & Lange (2001) noted in children with ADHD that handwriting became more accurate and legible, but not faster using Methylphenidate. The link between executive functioning and motor control may in the future be an area of increased interest in research and provide a potential focus for pharmaceutical intervention. It is of interest to note that in the *European Clinical Guidelines for ADHD* (Taylor et al, 2004) DCD is highlighted as one of the comorbid disorders, and states that 'if significant interference with academic achievements or activities of daily living is observed, treatment with stimulants seems to be indicated.'

Further research is required in order to gain a greater understanding of the different subtypes or individuals, and how to further specify treatment approaches for these groups as compared to the whole, as has been done for ADHD.

## **FUTURE DIRECTION AND CHALLENGES**

In the U.K., as in many other countries in the past few years, there has been increased parental awareness of DCD. This has resulted in increased demand on available services. One of the challenges for supporting children and their families with DCD will be providing effective and consistent management models based on a good evidence base and working with parents and children at the centre of the intervention process. A consensus statement produced by professionals from a wide range of disciplines including health, education and psychology in the U.K. was launched following a series of meetings funded by the ESRC has begun this process and remains available from <http://www.dcd-uk.org>.

A starting point would be for clinicians to make sure the initial enquiry not only looks across at the developmental spectrum, but also provides a method of triaging patients, so that those with the most complex difficulties do not 'sit waiting' for support or therapy for several years. Working jointly with paediatricians, child and adolescent psychiatrists, and allied health professionals is essential to the improvement of both efficacy and efficiency and to minimize the long term sequelae common among children with DCD. There is also a need for provision that takes into consideration the overlapping picture of developmental disorders rather than the segmentation of services that currently commonly exists is essential (Kirby et al, 2007).

In designing service provision it is important to consider that allied health professionals such as Occupational Therapists will never be able to solely provide the necessary amount of direct intervention. Parent training must also be developed alongside education as a key consultative approach to maximize impact and produce positive outcomes.

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## **USEFUL WEBSITES**

<http://www.dystalk.com/talks>

Developmental Disorders experts talk about a variety of developmental Disorders, including DCD.

[http://dcd.canchild.ca/en/?\\_mid\\_=3276](http://dcd.canchild.ca/en/?_mid_=3276)

This Canadian site has some excellent materials to support parents, educational and health professionals

<http://www.dyspraxiaireland.com/>

The Dyspraxia Association, Ireland

[www.dyspraxiafoundation.org.uk](http://www.dyspraxiafoundation.org.uk)

The Dyspraxia Foundation, UK has a wealth of information for parents, professionals and adults with Dyspraxia/DCD.

[www.dcd-uk.org](http://www.dcd-uk.org)

This website contains information relating to the 2006 Leeds Consensus Statement.

<http://www.hdcd.org.uk/>

The website of the Highland Developmental Co-ordination Disorder group contains a wealth of information for parents and has also produced a large selection of books, educational materials and DVDs.

<http://www.dyspraxicadults.org.uk/>

This forum provides an opportunity for adults with Dyspraxia/DCD to post messages around a variety of topics.

<http://www.dyspraxicteens.org.uk/forum/index.php>

This forum provides an opportunity for adolescents with Dyspraxia/DCD to share stories.

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