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Assessment of gait characteristics and orthotic management in children with Developmental Coordination Disorder: Preliminary findings to inform multidisciplinary care

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ABSTRACT

Developmental Coordination Disorder (DCD) is a neurodevelopmental disorder characterised by impaired motor co-ordination and awkward gait. Despite self-reported findings of pes planus and joint hypermobility in children with DCD, there is little objective evidence regarding the clinical management of the foot in children with DCD. The aims of this research were to report clinical findings of foot posture and lower limb hypermobility in children with DCD and to evaluate the impact of foot orthoses on spatio-temporal gait parameters. Children with DCD were recruited into the study. Participants were randomly assigned to an intervention group who received foot orthoses at the start of their rehabilitation programme or to a second group who received foot orthoses at the end of their intervention programme. Foot posture was assessed with the *Foot Posture Index* and lower limb hypermobility assessed with the *Lower Limb Assessment Score*. The effect of foot orthoses was evaluated through assessment of spatio-temporal gait characteristics at baseline and post-rehabilitation programme. Fourteen children were recruited (mdn age 7.5 years) with nine children assigned to the group receiving orthoses early (mdn age 8 years) and five children assigned to the post-rehabilitation orthoses group (mdn age 6.5 years). A pes planus foot posture (FPI score = 8) and lower limb hypermobility (LLAS score = 11) were observed. Changes in spatio-temporal gait parameters failed to reach significance ($p > .012$) following orthotic intervention but demonstrated a trend towards a decreased cadence and increased double support duration. Despite non-significant findings this work offers preliminary support for podiatric intervention in the rehabilitation of children with DCD. Further work is required to understand the biomechanics of gait in children with DCD and appreciate the role of podiatry as a component of multidisciplinary care.

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1. Introduction

Developmental Coordination Disorder (DCD) is a neurodevelopmental disorder characterised by impaired motor coordination and reduced ability to perform activities of childhood (Mandich, Polatajko, Macnab, & Miller, 2001; Polatajko & Cantin, 2006). Awkward and variable execution of movement (Raynor, 2001; Rosengren et al., 2009), reduced muscle strength and power (Raynor, 2001), pes planus (flat feet) and joint hypermobility (Kirby & Davies, 2006) have been reported

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in DCD. Rehabilitation for children with DCD requires a multidisciplinary approach underpinned by contemporary theories of human movement science (Polatajko & Cantin, 2006). Yet despite previous findings of flat feet and joint hypermobility (Kirby & Davies, 2006), there is little objective evidence regarding the clinical management of the foot in children with DCD.

It has been suggested that foot orthoses, as an addition to current management regimes for children with DCD, are warranted to address aberrant mechanics of the foot and lower limb that are associated with pes planus and joint hypermobility (Kirby & Davies, 2006). Foot orthoses are devices worn in the shoe which alter loading patterns during walking. Foot orthoses have been reported to prevent lower limb injury and reduce symptoms associated with soft tissue stress (Collins, Bisset, McPoil, & Vicenzino, 2007; Landorf & Keenan, 2000; Williams & Nester, 2010). In the paediatric context orthoses have also been reported to improve pain and disability in children with Juvenile Idiopathic Arthritis (Powell, Seid, & Szer, 2005). Nevertheless, recent conclusions from a Cochrane review (Rome, Ashford, & Evans, 2010) confirmed that further evidence was required to determine the efficacy of orthoses in the management of childhood conditions. Little is currently known about the clinical management of pes planus and joint hypermobility in children with DCD. The aims of this research were twofold: (1) to report clinical findings of foot posture and lower limb hypermobility in children with DCD and (2) to evaluate the impact of foot orthoses on spatio-temporal gait parameters.

2. Methods

2.1. Participants

Children with a diagnosis of DCD aged between 6 and 11 years of age referred to a Physical and Developmental Assessment rehabilitation programme within the Children's Therapy Service at Medway Community Healthcare were considered for participation in the study. Children referred into this programme were entering a seven week programme designed to give children with DCD the opportunity to practice and experience success with skills they found difficult. This consisted of clinical input from occupational therapists (for visual motor integration, visual perception, and fine motor skill development), physiotherapists (for gross motor skill development, core stability and co-ordination) and podiatry (for foot assessment and foot orthoses). Prior to entry onto the programme participants were provided with study information. Parents of all children suitable for inclusion provided written consent and children were asked for assent prior to participation. Ethical approval was granted by the University of East London Research Ethics Committee and Lewisham Local Research Ethics Committee.

All children entering the standard rehabilitation programme were screened for inclusion. Children with any medical complications likely to affect gait beyond those typical of DCD were excluded from the study. This excluded any condition affecting neuromuscular integrity and/or orthopaedic conditions (such as Talipes Equino Varus) that might lead to a gait changes. Foot posture was screened prior to participation and those presenting with a *Foot Posture Index* (Redmond, Crosbie, & Ouvrier, 2006) score of greater than +4 (indicating a pronated foot type) were invited to participate. Although arbitrary this level of cut-off was chosen to exclude children who would not normally be considered for foot orthoses due to having a typical arch profile for age. The need to wear appropriate footwear was discussed with the family prior to inclusion and children unwilling to wear footwear suitable for use with an orthotic device (low heeled, fastening, supportive footwear) were also excluded from the study. All screening and measurements were conducted by the same clinician (SS).

Twenty two children were approached to participate in the study. All were male, white British and presented with foot posture scores greater than 4. Twenty children consented to participate in the study but five failed to attend the therapy session. One participant withdrew during the programme of research and fourteen participants (mdn age 7.5 years) progressed to completion of the study.

2.2. Classification of foot posture

Foot posture was evaluated with the *Foot Posture Index* (Redmond et al., 2006). This index had good reliability for assessment of the paediatric foot (Morrison & Ferrari, 2009) and was conducted with each participant standing barefoot. This measure involved assessment of (a) talar head palpation, (b) curvature at the lateral malleoli, (c) inversion/eversion of the calcaneus, (d) talonavicular bulging, (e) congruence of the medial longitudinal arch, and (f) abduction/adduction of the forefoot on the rearfoot. A score between +2 to –2 was assigned for each measure creating a composite score ranging from +12 to –12.

2.3. Lower limb assessment score

The *Lower Limb Assessment Score* (LLAS) was used to measure lower limb hypermobility (Ferrari, Parslow, Lim, & Hayward, 2005). The LLAS is a 12 point score of each lower limb based upon assessment of (a) hip flexion, (b) hip abduction, (c) knee hyperextension, (d) knee anterior drawer test, (e) genicular rotation, (f) ankle joint dorsiflexion, (g) ankle joint anterior drawer, (h) subtalar joint inversion, (i) midtarsal joint inversion, (j) midtarsal joint ab/adduction and dorsi/plantarflexion, (k) 1st metatarsophalangeal joint dorsiflexion, and (l) weight bearing subtalar joint pronation. Each joint is scored one if the movement was excessive (based upon defined criteria) and a score of zero was assigned if not (Ferrari et al., 2005). Children

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