Longitudinal Change in Foot Posture in Children with Cerebral Palsy

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Introduction: Foot deformities are common but the evolution of dynamic foot postures is not well documented for children with cerebral palsy (CP). The purpose of this study is to identify unique trends in the development of foot deformity in children with CP from early walking to adolescence using a pedobarograph.

Clinical Significance: Documenting trends in dynamic foot posture for children with CP during their growing years will allow clinicians to better understand and treat the underlying mechanisms leading to foot varus and valgus deformities.

Methods: Foot pressure was evaluated in children with spastic CP in this IRB approved prospective longitudinal study and compared to age-matched typically developing (TD) children. The first visit was when the children were 33±7 months old. Children were then evaluated every six months until they were 5, and once a year until they were 11 (5 visits minimum for inclusion). GMFCS was assigned at age 6-8 years. We excluded data collected after boney foot surgeries or tendon transfer, but not after soft tissue lengthening surgery. For each visit, the average of 3 dynamic foot pressure measurements was analyzed using the F-Scan measurement system (Boston, MA). Outcome measures included the coronal plane pressure index (CPPI) and heel impulse. CPPI is a ratio of the medial and lateral pressure impulses in the midfoot and forefoot regions. ANOVA with Tukey post-hoc tests were used to compare the groups. Data were grouped and analyzed graphically using a thin plate spline analysis package for R statistical software.

Results: Ninety-six children with spastic CP were initially recruited and fifty-one children (16 unilateral, 35 bilateral involvement; 37 GMFCS I/II, 14 III/IV; n=847) met inclusion criteria. We compared this data to age-matched data from 334 feet of TD children (Figure 1). Variability in foot pressure data was higher in the children with CP than it was in the TD group. From age 3 to 11 years, CPPI was higher (valgus) in children GMFCS III/IV compared to TD (p<0.05 for all except age 7), and this was consistent over time. In the GMFCS I/II group, CPPI was higher than TD from age 3 to 5 (p<0.05), but then decreased to the normal range. Heel impulse was reduced in both GMFCS I/II and III/IV groups compared to TD regardless of age (p<0.05), and the III/IV group had less heel contact than the I/II group (p<0.05).
Children with CP are predisposed to abnormal foot mechanics for multiple reasons. Impaired tone and motor control, disturbances in balance, and abnormal biomechanical influences on the legs all have the potential to produce deforming forces on the foot. The purpose of this study was to identify unique trends in foot posture development for children according to functional level. The development of dynamic foot posture in walking is highly variable in children with CP especially at early ages. Young children with CP tend to have a valgus foot distribution relative to TD. Valgus tends to persist in children with GMFCS levels III and IV and to normalize in children with GMFCS levels I and II. Due to variability in the natural history of foot posture in children with CP, conservative management of coronal plane foot deformity is suggested, especially in young children and those ambulating without an assistive device. Further research is needed to identify the specific factors that influence these abnormal trends in foot posture development in children with CP.


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