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Long-term effects of a dynamic ankle foot orthosis on a patient with cerebral palsy following ischemic perinatal stroke – a case study

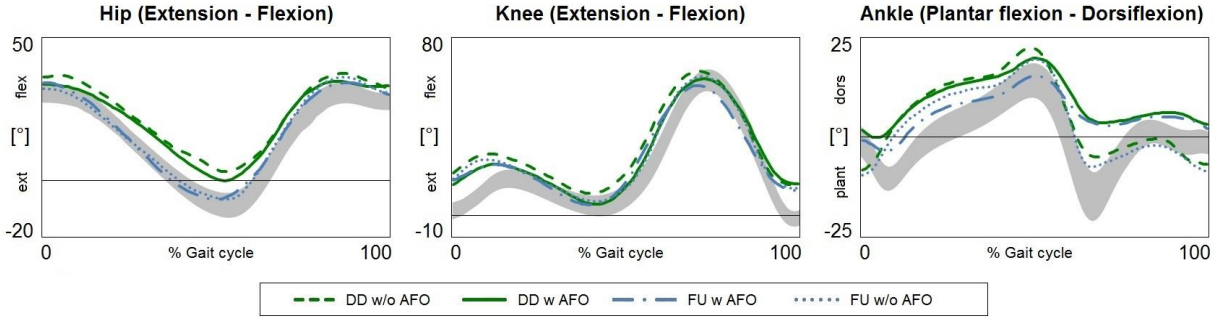
Introduction: Ischemic perinatal stroke (IPS) is a common cause of cerebral palsy (CP) in new-born infants. Those children develop neurological deficits which lead to gait disorders. Ankle foot orthoses (AFOs) are an important factor in continual gait improvement for children with CP [1]. A well-structured orthotic treatment can assist physiotherapeutic approaches and create new cerebral connections by using the right motor impulses [2].

Research Question: Are there long-term changes in spatio-temporal and kinematic gait parameters by wearing dynamic AFOs?

Methods: A 15-year-old female patient with CP (hemiparesis of left body-side, crouch gait) is supplied with a dynamic AFO (carbon-composite, adjustable range of motion, defined pivot point). The AFO is adjusted to the patient's individual normal posture [3]. On the day of delivery (DD) and at the follow-up after 3 months (FU), gait analyses were performed - each with and without AFO. Thereby, measurements of hip, knee and ankle angle plus step/stride length, velocity, cadence and time of stance and swing were taken.

Results: Measurements on DD showed increased step length (+5%), longer single-supported (+8%) and shorter double-supported phase (-19%) with AFO. Ankle plantar flexion diminished in swing until loading response by 7° and knee flexion in stance by 5°. FU showed increased stride length (+5%), velocity (+8%) and cadence (+2%) plus reduced hip (-10°) and knee flexion (-3°) in stance with and without AFO, compared to DD.

	Day of Delivery (DD)		Follow-Up (FU)	
	w/o AFO	w AFO	w/o AFO	w AFO
Step length [m]	0.62 (± 0.01)	0.65 (± 0.02)	0.65 (± 0.03)	0.67 (± 0.05)
Stride length [m]	1.35 (± 0.00)	1.37 (± 0.03)	1.42 (± 0.04)	1.41 (± 0.03)
Velocity [m/s]	1.14 (± 0.00)	1.16 (± 0.06)	1.23 (± 0.05)	1.26 (± 0.02)
Cadence [steps/min]	102 (± 1)	102 (± 3)	103 (± 3)	107 (± 3)
Single support [s]	0.39 (± 0.01)	0.42 (± 0.02)	0.42 (± 0.03)	0.37 (± 0.02)
Double support [s]	0.21 (± 0.01)	0.17 (± 0.02)	0.17 (± 0.02)	0.18 (± 0.02)



Discussion: On DD the AFO improved spatio-temporal and kinematic gait parameters. Enabling plantar flexion at LR and dorsiflexion in swing are immediate effects of the dynamic AFO. During three months of wearing the AFO the CP patient had come closer to a physiological gait which shows in a less flexed hip and ankle during stance with and without AFO at FU. The dynamic properties of the AFO improve spatio-temporal gait parameters even without AFO. An adaptation process is stated by these long-term changes in gait but the presence of new cerebral connections after IPS must still be proved.

References: [1] Becher J, JPO 2002; 14(4):143-9 [2] Horst R, Thieme 2005 [3] Sabbagh D et al, Gait Posture 2015; 42(S1):S80