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Short communication

O 016 - Investigating the roll-over shape in children with cerebral palsy walking with and without ankle foot orthoses

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1. Introduction

Children with cerebral palsy (CP) often show excessive knee flexion during walking. To counteract knee flexion, Ankle-Foot Orthoses (AFOs) are frequently prescribed. The effectiveness of AFOs is dependent on their mechanical characteristics, e.g. stiffness [1] and alignment [2]. The Roll-over Shape (RoS) has been proposed as a parameter to quantify the AFO's mechanical behaviour and alignment [3]. The RoS has however never been investigated in children with CP walking with or without AFOs.

2. Research question

The aim of the study was to investigate the RoS with and without AFOs with different degrees of stiffness in children with CP walking walking in flexed knee gait.

3. Methods

Fifteen children with CP walking with excessive knee flexion participated, and were prescribed a custom-made, ventral shell AFO with a rigid, full-length footplate and integrated ankle hinge which can be set into different degrees of stiffness (NeuroSwing®, Fior & Gentz). All participants walked barefoot, with shoes only and with AFO with a rigid, stiff and flexible hinge setting. Centre of pressure (CoP) and shank kinematics of three steps of the most affected leg were collected while walking on a 10 m walkway. RoS was determined during single support, based on a circular fit of CoP data in the local reference frame of the shank [4]. The radius and arc length were calculated and normalized for shank length.

4. Results

Circular RoS fitting was always possible for all subjects while walking barefoot, while in the other walking conditions some data could not be fitted, especially for the stiff (N = 7) and rigid (N = 9) AFO conditions. Compared to barefoot and shoes-only, radius and arc length increased with AFOs (Table 1). In addition RoS was translated forward in barefoot condition relative to others.

5. Discussion

The backward shift of the RoS (Figs. 1 and 2) and increased radius and arc length while walking with AFOs (Table 1), is likely to be caused by the decreased inclination of the shank in the AFO conditions during single stance. A larger radius could thus indicate less shank inclination (i.e. better shank alignment) during walking. However, RoS could not be fitted in all cases, suggesting an absence of a circular RoS during walking with AFOs. As a result of the rigid footplate and restricted ankle range of motion the second rocker motion and roll-over of the

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Table 1
Generalized Estimation Equation of mean (SD) radius and arc length of the RoS (normalized for shank length) during single support for different walking conditions.

	Barefoot N = 15	Shoes N = 13	Flex N = 12	Stiff N = 7	Rigid N = 9	Wald *X*	*p*	*Post-hoc*
Radius	0.32 (0.18)	0.31 (0.19)	0.51 (0.31)	0.46 (0.15)	0.41 (0.23)	10.5	0.03	BF-AFOf* BF-AFOs* SH-AFOf*
Arc length	0.22 (0.10)	0.21 (0.07)	0.24 (0.08)	0.26 (0.06)	0.31 (0.06)	10.1	0.04	BF-AFOr* SH-AFOf* SH-AFOr*

BF = barefoot; SH = shoes; AFOf = flexible AFO; AFOs = stiff AFO; AFOr = rigid AFO.

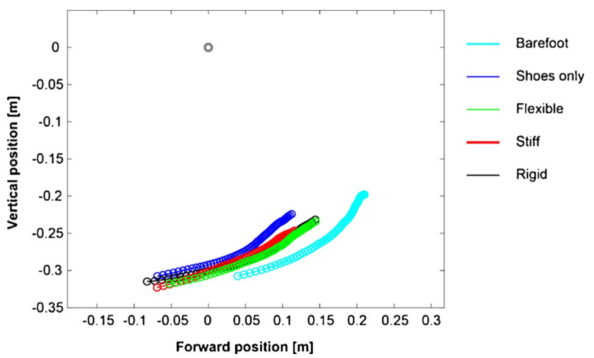

Fig. 1. Mean RoS (n = 15), normalized for shank length, during single support for different walking conditions. Grey dot indicates the lateral epicondyle, i.e. origin of the shank's local reference frame.

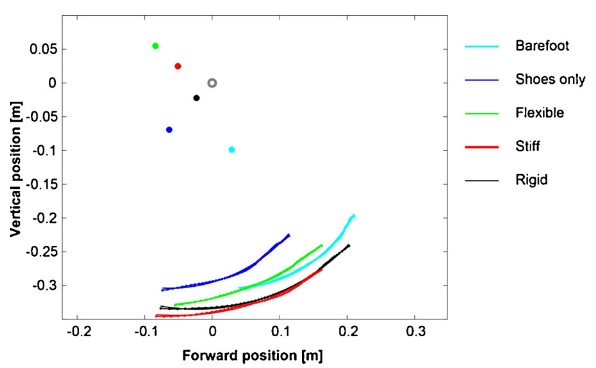

Fig. 2. Mean RoS (normalized for shank length) during single support for walking barefoot (n = 15), shoes-only (n = 13), flexible AFO (n = 12), stiff AFO (n = 7), rigid AFO (n = 9). Coloured dots indicate the centre of each circular fit. Grey doto indicates the lateral epicondyle, i.e. origin of the shank's local reference frame.

foot seems lost. As such a lack of fitting of the data is also informative on the behaviour of the AFO. Although the relation between RoS and the AFO's effects on knee and ankle kinematics should be further investigated, our data suggests that RoS analysis could be informative of AFO behaviour and alignment in children with CP.

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