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Short communication

O 080 - Kinematic comparison of the Oxford Foot Model and Rizzoli Foot Model during voluntary equinus and crouch gait in healthy adults

W. Schallig[a,b,*], J. van den Noort[a,b], J. McCahill[c], M. Maas[b], J. Harlaar[a,d], M. van der Krogt[a]

[a] VU University Medical Center, Department of Rehabilitation Medicine, Amsterdam Movement Sciences, The Netherlands
[b] Academic Medical Center, Department of Radiology and Nuclear Medicine, Amsterdam, The Netherlands
[c] Oxford Gait Laboratory, Nuffield Orthopedic Centre, Oxford, United Kingdom
[d] Delft University of Technology, Biomechanical Engineering, Delft, The Netherlands

1. Introduction

Individuals with cerebral palsy often walk with atypical gait patterns like equinus or crouch gait. Several multi-segment foot models have been developed [1] to measure the abnormal foot kinematics of these gait patterns. The Oxford Foot Model [2] (OFM) and Rizzoli Foot Model [3,4] (RFM) are used most frequently in both clinical practice and research [1]. Their different model characteristics (e.g. marker placement and axis definitions) will likely result in different kinematic output. However, these differences have not yet been extensively compared, especially not in pathological gait patterns.

2. Research question

What are the differences in kinematic output between the OFM and RFM during voluntary equinus and crouch gait?

3. Methods

Ten healthy adults (26.6 ± 2.6 years) underwent 3D gait analysis with the Newington marker model [5] placed on both lower extremities and with both OFM and RFM marker sets on the right foot. After a static trial, subjects walked 6 times in normal, equinus, and crouch gait patterns. Markers were captured by a 12-camera Vicon system. Five force plates (AMTI) were used to determine gait events. Trials were time-normalized to 100% of the gait cycle and the average over 3 trials was used. Joint angle waveforms and corresponding range of motion (ROM) values were compared between models using repeated measures ANOVAs and post-hoc analyses with Bonferroni correction. For the joint angle waveforms these tests were performed with statistical parametric mapping [6].

4. Results

Here we show only sagittal plane results of the hindfoot-shank (HF-SH) and the forefoot-hindfoot (FF-HF) angles (Fig. 1). For both angles, an interaction effect between gait pattern and model was found. For HF-SH angle, OFM showed more dorsiflexion compared to RFM during the late stance for normal and crouch gait. Consequently, OFM demonstrated a larger ROM during the trial than RFM (Table. 1). For the FF-HF angle, RFM showed more plantar flexion compared to OFM towards the end of stance for all gait patterns as well as a higher ROM. For voluntary equinus gait this difference was most prominent, since it was present from 33 to 63% of the gait cycle.

5. Discussion

This study demonstrated relevant differences in kinematic output between OFM and RFM, not only during normal gait, but also during voluntary equinus and crouch gait. In general, the dynamic foot deformation expresses as more HF-SH motion in OFM and as more FF-HF motion in RFM. Interestingly, the differences between the models depend on the gait pattern. It is important to keep this in mind when applying a specific model to study a pathological gait pattern in a clinical population. The differences between the models are probably a result of different axes definitions and different marker locations with a different sensitivity to skin movement artefacts.

* Corresponding author at: VU Medical Center, Department of Rehabilitation Medicine, Amsterdam, The Netherlands.
E-mail address: w.schallig@vumc.nl (W. Schallig).

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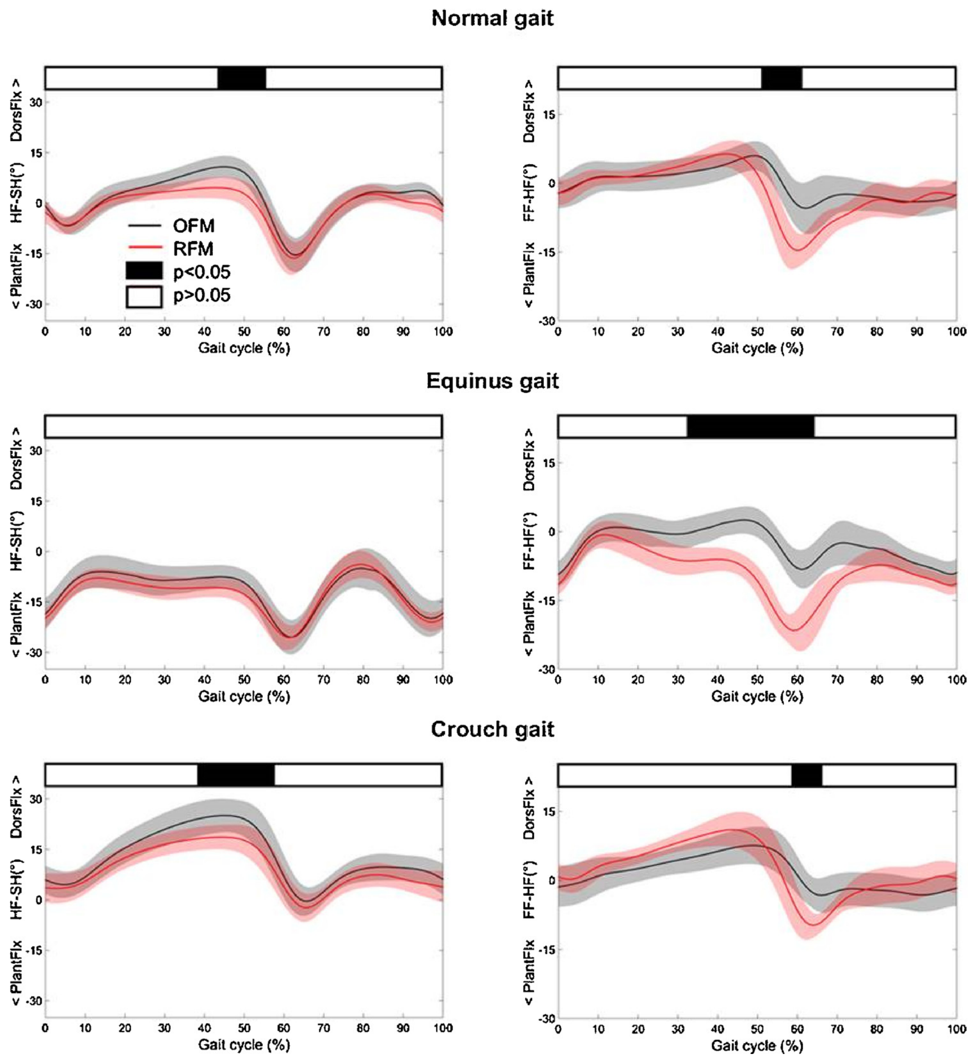

Fig. 1. The dorsiflexion angle of the HF-SH (left column) and FF-HF (right column) for normal, equinus and crouch gait. The shaded areas are SD around the group mean for OFM (black) and RFM (red). Significant differences are shown at the top of the graphs. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article).

Table 1
Average range of motion (ROM) values (mean ± SD) for the different angles and gait patterns. *significant difference between OFM and RFM with $p < 0.01$.

Angle	Gait pattern	ROM OFM (°)	ROM RFM (°)
HF-SH	Normal*	27.0 ± 3.5	21.9 ± 3.4
	Equinus	22.5 ± 3.4	22.8 ± 3.7
	Crouch*	26.3 ± 4.0	21.7 ± 3.0
FF-HF	Normal*	13.1 ± 3.2	22.6 ± 3.5
	Equinus*	14.0 ± 3.2	22.1 ± 5.9
	Crouch*	12.4 ± 2.8	22.0 ± 3.3

References

[1] Leardini, Carvaggi, Handbook Of Human Motion, (2016), pp. 1–22.
[2] Stebbins, et al., Gait Posture 23 (4) (2006) 401–410.
[3] Leardini, et al., Gait Posture 25 (3) (2007) 453–462.
[4] Portinaro, et al., Foot Ankle Res. 7 (1) (2014) 57.
[5] Davis et al, Hum. Mov. Sci. 10 (5) (1991) 575–587.
[6] Pataky et al, Biomechanics 43 (10) (2010) 1976–1982.