Forefoot adduction and ankle inversion as kinematic indicator of relapse clubfoot

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Introduction

A clubfoot is characterized by a three-dimensional deformity with an equinus, varus, cavus and adduction component (1). Nowadays the Ponseti method is the preferred treatment for clubfoot, aiming to achieve a normal appearing, functional and painless foot (2). The re-occurrence of clubfoot components in treated clubfoot, a relapse, is a known problem in clubfoot patients. 3D gait analysis can be used in assessment of foot function and residual deviations in gait or possible relapses (3-6).

Understanding the kinematic characteristics of relapse clubfoot compared to successfully treated clubfoot could aid early identification of a relapse and improve treatment planning. Gait analysis is a frequently applied tool to analyze differences in gait between clubfoot and healthy controls. However, the usage of multi-segment foot models is rare. The usage of a multi segment foot model is essential in order to grasp the full complexity of the multi-planar and multi-joint deformity of the clubfoot.

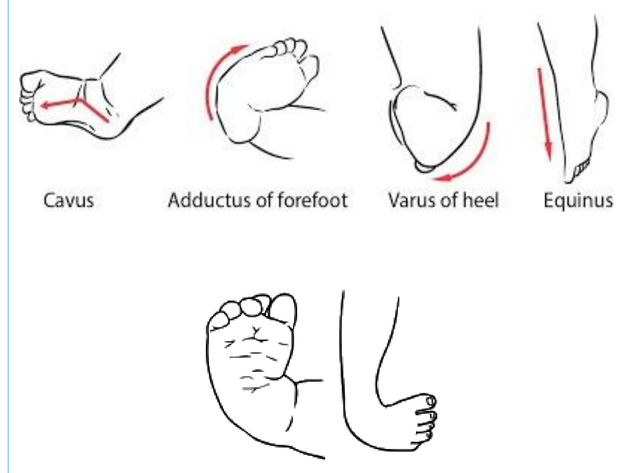

Figure 1: *Clubfoot - a three-dimensional deformity*

Aim

The purpose of this study was to identify differences in foot kinematics, using a multi-segment foot model, during gait between Ponseti treated clubfoot patients with and without a relapse and age-matched healthy controls.

Methods

Participants

- 15 patients with relapse clubfoot, 11 patients with clubfoot and 15 controls were included for gait analysis
- Age 4-8 years old
- Patients were treated following Ponseti

Analysis

- Kinematic data were collected using the extended Helen Hayes model combined with the Oxford Foot Model (7).
- Statistical parametric mapping and discrete analysis of kinematic gait parameters of the pelvis, hip, knee, ankle, hindfoot and forefoot in the sagittal, frontal and transversal plane.

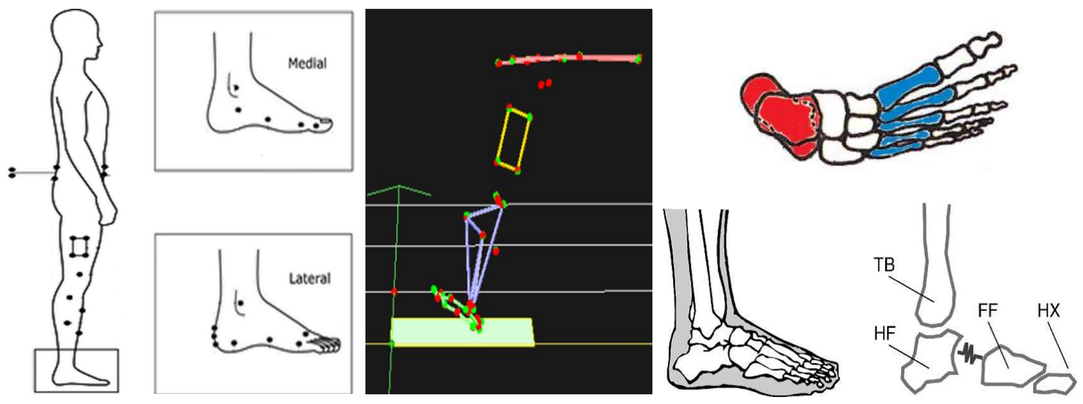

Figure 2: *Marker placement.*

Results

Table 1: *Demographic data*

	N	Male	Age (years) Mean (sd)	Height (cm) Mean (sd)	Mass (kg) Mean (sd)	Walking speed (m/s) Mean (sd)	Affected foot
Relapse	15	9*	6.0 (1.4)	118 (9.0)	23.7 (6.0)	0.99 (0.15)	7 bi / 6 uni
Clubfoot	11	9*	5,6 (1,6)	117 (9,0)	21,1 (3,9)	0.99 (0.06)	4 bi / 7 uni
Control	15	8*	5.7 (1.4)	119 (11.0)	22.8 (5.2)	1.07 (0.16)	

**Other female*

Results

Relapse patients showed significantly increased forefoot adduction in relation with the tibia and the hindfoot. Furthermore, relapse clubfoot showed an increased internal rotated foot during the full gait cycle and increased inversion of the ankle during stance.

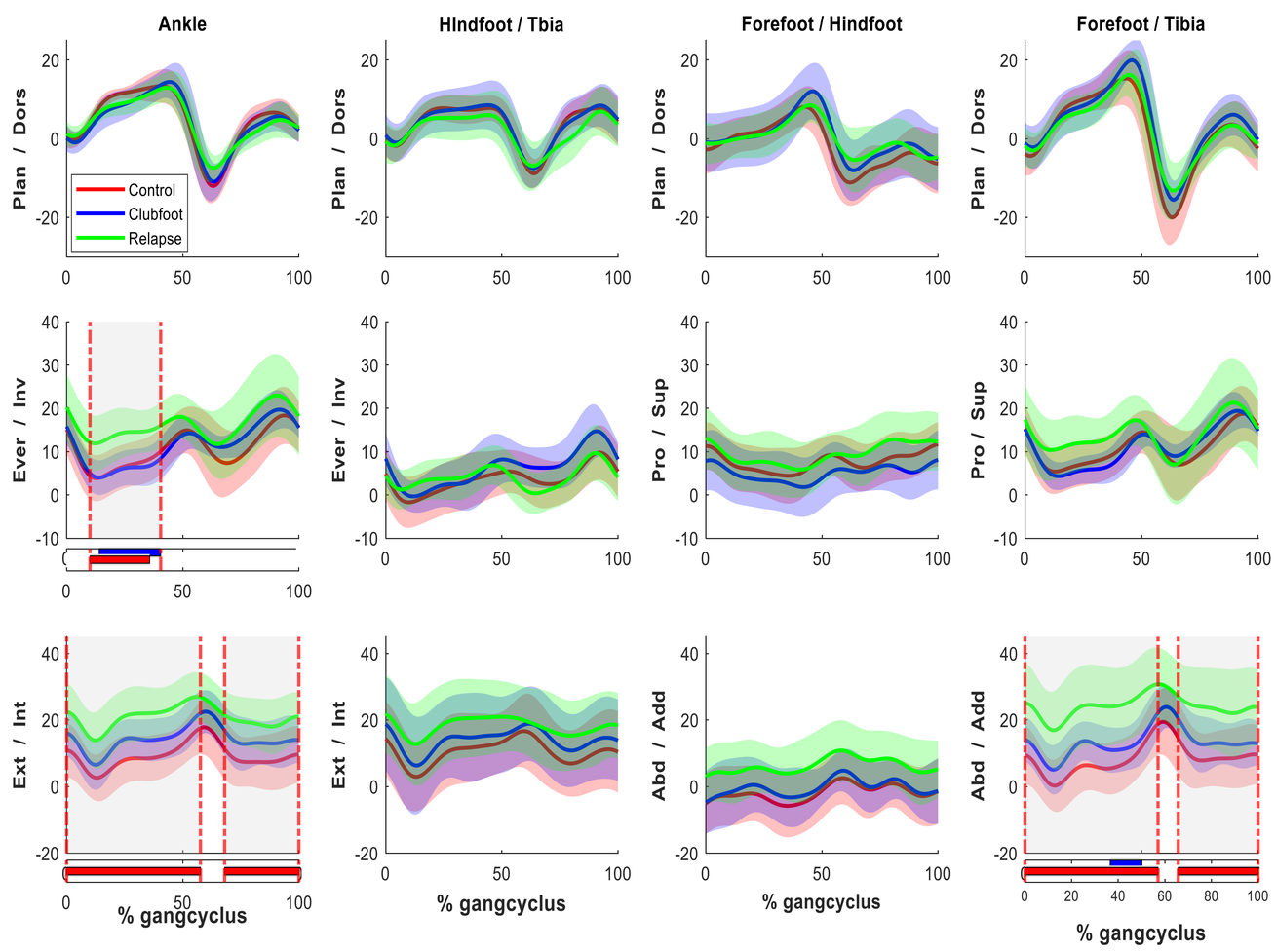

Figure 3: *Ankle and foot kinematics during gait of children with relapse clubfoot (green line), children with clubfoot (blue line), versus control (red line). Colored shading shows the standard deviation and the vertical line indicates stance versus swing. Post-hoc results are shown in bars which indicate statistically significant results at the color-marked moment of the gait cycle: relapse versus clubfoot (blue bars, p < 0.005), relapse versus controls (red bars, p<0.005)*

Discussion and Conclusion

Forefoot adduction and ankle joint inversion could be kinematic indicators of relapse clubfoot, which might be useful in early identification of a relapse clubfoot. Subsequently, this could aid to optimize clinical decision making and treatment planning for children with clubfoot.

References

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