Discussion: It is shown that the energy requirement for balance control can be substantial. The average increase of 0.86 W/kg in tandem stance with eyes closed, is equivalent to a 17% increase in oxygen consumption during walking, which is a common increase for pathological gait [1] The relation between energy consumption and posturography measures used was low. This indicates that these conventional measures for postural control do not reflect the effort for balance control. We conclude that the effort for balance control could possibly play an important role in the increased energy cost of pathological gait.

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O062

Clinical usefulness of three dimensional gait analysis in children with pes planus

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Summary: Increased talocalcaneal angle (TCA) in simple X-ray was related to decreased maximal external rotation and increased maximal internal rotation of knee joint in three dimensional gait analysis.

Conclusions: Dynamic assessment such as three dimensional (3D) gait analysis is useful tool to assess the ambulation status in children with pes planus.

Introduction: This study is to assess the ability of lower limb computed tomography (CT) and 3D gait analysis to identify the change of lower limb rotation angle resulted from foot angle deviancy in pes planus.

Patients/Materials and Methods: Thirteen children with pes planus were selected in this study. Radiologic measurements included TCA, talometatarsal angle (TMA), calcaneal pitch in foot X-ray and femoral anteversion, tibial torsion and rotation CT. 3D gait analysis was also performed. We investigated the correlation between radiological data and parameters of gait analysis.

Results: Increased TCA correlated with maximal internal and minimal external rotation angle of knee joint in 3D gait analysis. But no parameters in foot X-ray was not found to have the relation to tibial rotation angle in CT.

Discussion: Gait pattern in subjects with pes planus has been investigated in many reports. Excessively pronated rearfoot found in children with pes planus lead to inefficient plantarflexion of the ankle during the terminal stance phase. When gait analysis in subjects with pes planus was compared with that in normal individuals, the forefeet of pes planus showed less adduction of forefeet and less dorsiflexion of hindfoot at push off, suggesting that individuals with pes planus showed restricted motion of ankle or foot structures during walking. However, there was a report documenting individuals with pes planus exhibited excessive dorsiflexion during late stance phase that resulted from excessive midfoot moblility. More internally rotated talus in children with pes planus is associated with larger TCA. Larger TCA indicates larger tibial internal rotation because internal rotation of the tibia was associated with internal rotation of the talus. This relationship could be found in the parameters obtained by dynamic and functional evaluation such as 3D gait analysis, not in CT.

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O063

Comparison of residual deformity in clubfeet using a clinical exam and the Oxford Foot Model

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Summary: The findings from the Oxford Foot Model (OFM) [1] identify the level of dynamic foot deformity (hindfoot and/or forefoot) and the source of rotation (tibial, hindfoot, and/or forefoot) providing important information in addition to a clinical examination in order to determine future management. Clinical examinations (CE) should be standardised to identify deformities in all three planes at hindfoot and forefoot levels.

Conclusions: In surgically treated clubfeet with residual deformity there was best agreement between the static foot postures and the dynamic kinematics of the hindfoot and forefoot in the coronal and transverse planes when using the OFM. The CE had best agreement to the static foot postures of the forefoot in the sagittal plane. Decreased range of motion in the sagittal plane was statistically significant in the forefoot and the hindfoot.

Introduction: Clubfeet treated by primary surgical release often have residual postural and dynamic deformities. The aim of this analysis was to compare the residual deformities identified in a standardised CE to the static weight bearing foot postures using the OFM; as well as the static weight bearing postures to the dynamic kinematics of the OFM.

Patients/Materials and Methods: A total of 24 patients (7 female and 17 male, age range 6 to 24 years) have been seen with this diagnosis – a total of 37 feet were compared to 15 age-matched controls. All patients had been surgically treated to correct foot deformity at an early age with a posterior-medial release. A standardised CE by a physiotherapist and foot model kinematics were collected using VICON MX F40, 12 camera system. The weight bearing CE foot postures were compared to the static foot model data and the static data was also compared to the dynamic kinematics to determine the percent of agreement. Kinematic abnormalities were defined by >1 standard deviation from the mean of the controls. The findings describe the hindfoot in relation to the tibia and the forefoot in relation to the hindfoot. The normalized arch height was compared to the clinical findings of cavus/ planus.

Results: Using the paired t-test ($p < 0.05$) there was a significant reduction in the sagittal plane range of motion for both the hindfoot ($p = 0.00$) and the forefoot in relation to the hindfoot ($p = 0.00$) in the OFM kinematics compared to controls.

Discussion: 45–85% agreement was found between the CE and the static foot data. This is despite a lack of universally accepted descriptors of foot deformity and precise identification of the location of deformity (hindfoot/ forefoot) in the CE. The range of agreement between the static foot postures and the kinematics of the OFM is 40–73%, indicating up to 60% of the residual clubfoot deformity may only be static or dynamic.

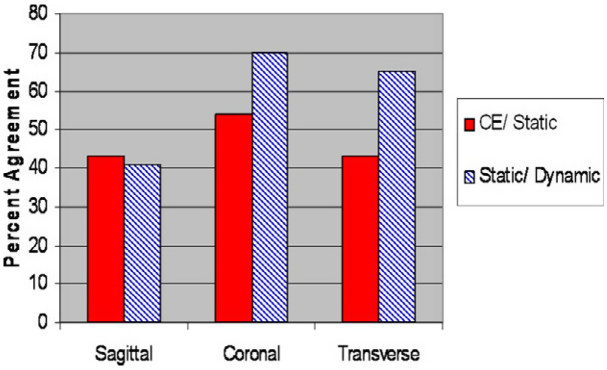

Figure 1. Hindfoot.

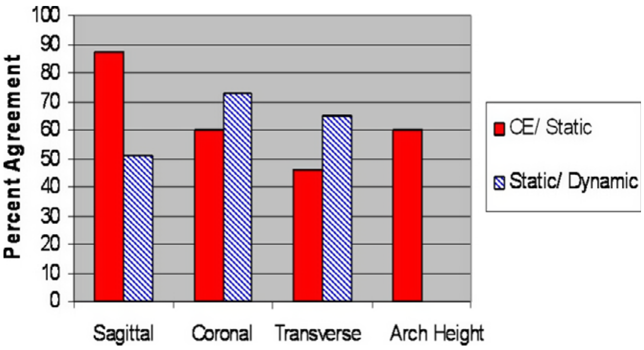

Figure 2. Forefoot.

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O064

Effect of rigid ankle-foot orthosis on lower limb joint range of movement and joint forces in spastic cerebral palsy

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Summary: The effect of rigid ankle-foot orthoses (AFOs) on joint forces in the cerebral palsy (CP) gait was investigated. The parameters studied were (1) maximum joint force and its position in the gait cycle, (2) temporal-spatial parameters and (3) the ranges of motion at hip, knee and ankle joints. Based on the cases studied, it was confirmed that AFOs improved gait by increasing the stride length and walking speed and correcting the equinus deformity. However, the joint forces increased at all three joints of the lower limb in both the hemiplegic and diplegic subjects.

Conclusions: In both hemiplegics and diplegics, although the patients' gait was improved by wearing AFOs, with significant improvements in stride length and correction of the dynamic equinus, the joint forces across all the lower limb joints were increased significantly.

Introduction: Ankle-foot orthoses have been extensively used in the ambulation of children with spastic CP. The benefits are gained by improving the foot and leg biomechanics and controlling muscle tone and spasticity [1]. Although, different types of AFO such as posterior leaf spring orthoses, dynamic orthoses and hinged orthoses are in use, the traditional rigid AFO continues to be the most frequently prescribed in the management of children with CP. Studies have reported the influence of various types of orthoses in CP gait [1]. However, joint force is one kinetic parameter which remains unexplored with no published studies. The purpose of this research was to study the influence of the rigid AFO on joint forces at the hip, knee and ankle during gait in patients with spastic CP.

Patients and Methods: Gait data was studied from nineteen children with spastic CP both with and without their own AFO. Those who required walking aids were not included. A further eight patients were excluded for a variety of reasons e.g. inappropriate foot placement on the Kistler® force platforms. As a result, 11 patients (7 hemiplegics and 4 diplegics) were studied, six female and five male with an average age of 11.8 years (range 8–17), mean height of 149.5 cm (range 125–177) and mean weight of 43.3 Kg (range 27–80). The data were analysed using Vicon® Plug-in-Gait model to obtain joint force curves, and the maximum joint force and the position where it occurred in the gait cycle were extracted.

Results: The temporal-spatial parameters included; cadence; stride length and walking speed. On wearing the AFOs, the stride lengths were improved in both the hemiplegic and diplegic subjects (mean increase of 19.6 cm in hemiplegics and 5.4 cm in diplegics). This was significant in the hemiplegics. The range of movement was calculated as the difference between the maximum and minimum angles occurring at the joint during the gait cycle. The range of movement was found to have increased at the hip and knee joints, but the increases were not statistically significant. It was found that the joint forces were significantly increased whilst wearing the AFO. The increases in joint forces were similar in the hemiplegic and diplegic subjects, with significant increases in the hip and knee joint forces along the vertical-axis and significant increases in the ankle joint force along the medial-lateral-axis.

Discussion: Firm conclusions cannot be drawn from the results obtained considering the limited number of patients, although this pilot study showed a trend towards increasing joint forces. More extensive research is required to confirm or refute these findings. Studies would also need to include data with shoes and no orthoses rather than comparing barefoot data with AFO and shoes.

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