Results: In DN and NoDN, altered foot kinematics was observed on each subsegments (p < 0.01). Both DN and NoDN showed a COP pattern more medially directed, together with excessive forefoot and midfoot plantar pressure and ground reaction forces (p < 0.001). DN's EMG analysis demonstrated in rectus femoris earlier activation at initial contact (p < 0.0007) and reduced activation during pre swing phase of gait. NoDN showed altered muscle activation on rectus femoris, gluteus medius and gastrocnemius lateralis (p < 0.04). Pathologic subjects displayed a nice correlation between the peak of envelope of lower limb muscles and the peak of each foot subsegments' tangential forces and angles (0.6 < R < 0.9, p < 0.01). Meanwhile an inverse correlation was found between the peak of envelope of tibialis anterior and the peak of each foot subsegments' tangential forces and plantar pressure (R < 0.5, p < 0.001).

Discussion and conclusion: Results showed this method has a good ability of describing diabetes subjects' biomechanics alterations. Such a characterization of diabetic foot could be useful in order to understand its aetiology and to plan prevention programs aiming at reducing plantar ulcer formation.

Disclosure: No significant relationships.

References


O62

Relationship between motion of the hallux and the foot in cerebral palsy

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Introduction: Foot deformity is a common occurrence in cerebral palsy (CP), affecting around 90% of the population [1]. The hallux is often implicated, with valgus or adduction deformity occurring most frequently. In addition, dynamic function of the hallux during gait is often compromised. However, the relationship between motion of the hallux and the rest of the foot is unknown. The aim of this study is to investigate this relationship, and thereby improve understanding of the role of the hallux during gait in children with CP.

Patients/materials and methods: Subjects included 67 children with diplegic CP (mean 11.8 yrs), 49 children with hemiplegic CP (mean 10.6 yrs), and 73 typically developing children (mean 10.2 yrs). Barefoot, level walking data were collected at self-selected speed using 12 Vicon MX cameras. Multi-segment foot motion was obtained using the Oxford Foot Model (OFM) [2]. Discrete, kinematic variables were extracted from the data, including average data during stance and swing, as well as range of motion across the whole gait cycle, for the hindfoot, forefoot and hallux. Averages between groups were compared using ANOVA, and Pearson’s moment correlation was used to assess relationships between variables within each group. Correlations were deemed significant at p.

Results: The hallux data varied across subjects within each group, with the CP groups exhibiting greater inter-subject variation than the typically developing children. As a result, there were no significant differences between the groups in any kinematic variable. However, correlations between hallux variables and other foot variables differed between groups. In the typically developing group, the only significant correlations found were between different hallux variables (for example, between hallux dorsiflexion and hallux valgus during stance). However, in the diplegic group significant correlations were discovered between forefoot supination and hallux valgus (Fig. 1), along with forefoot adduction and hallux valgus. In the hemiplegic group, a significant inverse correlation was found between hallux varus and hindfoot (ankle) dorsiflexion in particular (Fig. 2).

Discussion and Conclusion: While hallux motion appears to be independent of motion of the rest of the foot in typically developing children, this is not the case in CP. In particular, hallux valgus is directly related to pronation of the forefoot (with respect to both the hindfoot and the tibia) in diplegia. This alteration in loading of the hallux and the change in the balance of forces probably drives the dynamic deviation towards abduction/valgus. In contrast, movement of the hallux appears more closely associated with sagittal plane motion of the hindfoot in hemiplegia. It would appear that in hemiplegia it is the spasticity of the plantarflexors and toe flexors, and not the loading pattern, that drives the dynamic deviation of the foot and the hallux in these children. It would seem reasonable to assume that motion at the ankle and midfoot during walking influences hallux movement to some extent in both diplegic and hemiplegic CP. This has implications for treating dynamic foot deformity in this population. In some cases, dynamic hallux dysfunction may resolve spontaneously if other foot deformities are treated, where there is a relationship between foot and
hallux motion. In addition, this information could be used to help prevent the development of hallux deformity by addressing the primary foot deformities.

**Disclosure:** No significant relationships.

**References**


**O63**

**The comparison of patellofemoral joint forces between flat footed and normal subjects during stance phase of gait**

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**Introduction:** Foot hyper pronation may cause malalignment of the lower extremity, frequently leading to structural and functional deficits both in standing and walking [1]. Based on coupling between rear foot frontal plane motion and rotation of tibia, it is speculated that excessive pronation results in abnormal tibial rotation which increases stress on the joints of the lower extremity during weight bearing [2]. It has been postulated that abnormal subtalar joint motion is linked to knee joint problems like patellofemoral pain syndrome as it may affect knee mechanics. The purpose of this study was therefore to measure patellofemoral joint forces during stance phase of walking in subjects with hyper pronated foot and to compare them to the healthy subjects.

**Patients/materials and methods:** 10 subjects with neutrally aligned feet and 10 with hyperpronated feet aged 23 ± 2.5 years were selected via clinical examination. Kinetic and kinematic data were collected by using a force platform (Kistler, Switzerland) and six camera motion capture system (Qualisys, Ltd., Sweden) while subjects walked at their preferred speed. Mean and peak knee extensor mechanism forces were quantified using Newtonian inverse dynamics during stance phase of walking. Then, mean and peak patellar mechanism angles and patellofemoral joint forces were calculated in both groups.

**Results:** Significant higher amount of mean patellar mechanism angle and also mean and peak forces across the knee extensor mechanism were found in flat footed group compared to normal group [P < 0.05]. But there were no significant differences between groups when the peak patellar mechanism angle was taken into account [P > 0.05]. Moreover, statistical analysis revealed a significant difference in mean patellofemoral joint force between normal (178.3 ± 93.27 N) and hyper pronated foot groups (478.1 ± 191.5 N) [P = 0.001]. Peak patellofemoral joint force was also significantly higher in flat footed group (561.8 ± 279.6 N) compared to normal group (269.8 ± 193.8) [P = 0.019].

**Discussion and conclusion:** Increased patellofemoral joint force causes the patellofemoral joint pathologies like arthritis. It can be concluded that changes of the medial longitudinal arch height would alter the net external flexion moment, force applied to the extensor mechanism, patellar mechanism angle and consequently the patellofemoral joint forces during stance phase of walking, which through developing a tendency towards musculoskeletal injuries.

**Disclosure:** No significant relationships.

**References**


**O64**

**Characterisation of pes planovalgus by patients with Juvenile Idiopathic Arthritis with the Oxford Foot Model**

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**Introduction:** Patients with Juvenile Idiopathic Arthritis (JIA-P) often have affected ankle joints [1]. This could lead to pain which may result in deformities [2] like pes planovalgus. Until now, only static characteristics of the pes planovalgus were measurable. Descriptions of the behavior in dynamics, like walking, are lacking. The Oxford Foot Model [3], compared to conventional lower body models, divides the foot into three rigid segments (hindfoot, forefoot, hallux), which enables measurements of relative motion between the different foot segments. Thus the characteristics of foot deformities like pes planovalgus during gait can be measured. The aim of this pilot study was to assess functional impairment of pes planovalgus by JIA-P during the stance phase of gait.

**Patients/materials and methods:** The kinematic data of maximum hindfoot eversion and minimum longitudinal arch height were obtained by reflective markers during barefoot walking at self-selected speed. An 8-camera 3d-motion analysis system (200 Hz) (Vicon) was used. The patient group included five individuals (sex: f = 3, m = 2; age: 12 ± 1 yr; height: 1.5 ± 0.1 m; weight: 40 ± 2.8 kg) with at least one affected ankle joint and fixed pes planovalgus (≥ 5° and also heel valgus while toe-standing). In addition five voluntary, healthy peers (sex: f = 4, m = 1; age: 12 ± 2 yr; height: 1.5 ± 0.1 m; weight: 40.1 ± 8.4 kg) neither with rheumatic nor orthopedic or neurological disease served as control group (cg). Children with lower limb surgeries or orthopedic insoles in history were also excluded. For statistical analysis the Mann–Whitney U test (p = .05) was used to compare the kinematic data between these two groups.

**Results:** At comparable speed (1.2 m/s) JIA-P showed a significant increased maximum eversion in loading response (Mdn 7.3° inversion; cg Mdn 0.4° inversion; p = .05) and a significant decrease in minimum longitudinal arch height during stance phase (Mdn 17.9 mm; cg Mdn 19.5 mm; p = .05).

**Discussion and conclusion:** With the application of this special 3d gait model, characteristics of the JIA induced pes planovalgus can be measured. JIA-P still has a longitudinal arch height serving as shock absorption during walking. The results provide important quantitative information for medical care and physiotherapy of patients with JIA induced pes planovalgus. Further research with 15 patients is planned. In addition the Oxford Foot Model can be applied for the control of the longitudinal development of pes planovalgus. Finally in adulthood when longitudinal arch height is possibly lost the method can be additionally used for surgical planning.

**Disclosure:** No significant relationships.