P 2-11

Correlation of foot radiographs with kinematics during gait of children with motor disabilities

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Objectives
Clinical decisions about foot deformities in children with motor disabilities are mainly made through the radiographs of the foot and ankle. However, because the radiographs are static position data, it is not known exactly how foot kinematics are related to these static images during gait. The Oxford foot model(OFM) is a multi-segment model to estimate the hindfoot and forefoot motion on sagittal, coronal and transverse planes. Kinematics of foot and ankle during gait can be analyzed based on this model using motion capture system. The purpose of this study was to investigate whether foot radiographs were correlated with foot kinematics during gait using the OFM.

Subjects
This study reviewed foot radiographs and computerized gait analysis data from 30 ambulatory children with motor disabilities, such as cerebral palsy, spina bifida, brain tumor, etc.

Methods
We analyzed the foot radiographs on standing posture from all subjects. Talo-calcaneal angle and talo-1st metatarsal angle were measured in both lateral and anterior-posterior(AP) views. Calcaneal pitch angle was measured in lateral view as well. Walking was tested barefoot at a self-selected speed along a 8-m path, and the marker trajectories were recorded with an 6-camera optometric system for kinematic analysis (Vicon, Oxford, UK) computerized with a sampling rate of 100 Hz to measure the kinematic data (angle of each joint) during the gait cycle. A modified Helen Hayes marker set for lower limbs and OFM for foot and ankle were used. Spearman rank correlation coefficients were computed to evaluate the relationship between the foot radiographs and foot kinematics based on OFM during gait.

Results
Talo-1st metatarsal angles in lateral view were correlated with maximum forefoot dorsiflexion on sagittal plane(FFSP max) and talo-1st metatarsal angles in AP view were correlated with maximum forefoot abduction on transverse plane(FFTP max) during gait.($p<0.05$) Talo-calcaneal angles in AP view were correlated with maximum hindfoot valgus on frontal plane(HFFP max) during gait.($p<0.05$)

Discussion

According to this study, we could find that which parameters of static foot radiographs during standing were more correlated with abnormal foot kinematics during gait in children with motor disabilities. The larger the Talo-1st metatarsal angles in lateral and AP view, the greater the value of FFSP max and FFTP max. Additionally, the larger the Talo-calcaneal angles in AP view, the greater the value of HFFP max.

References

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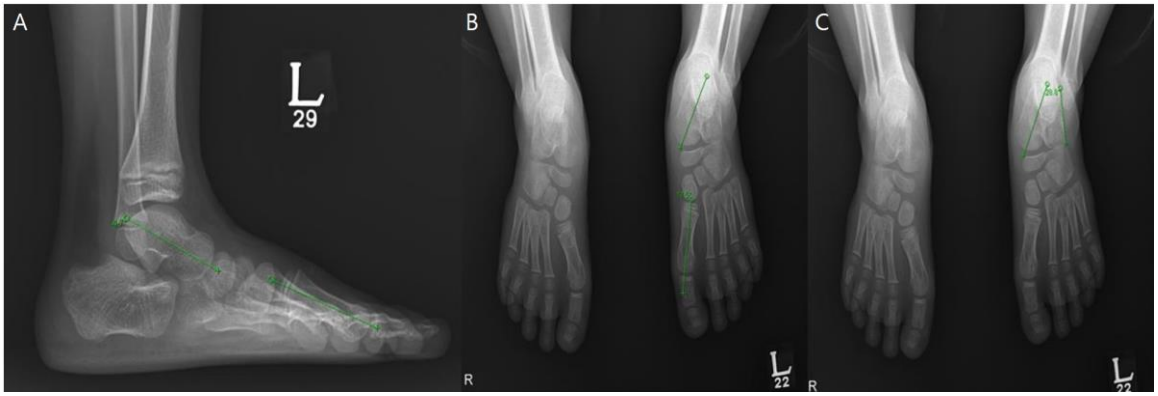

Figure 1. A : Talo-1st metatarsal angles in lateral view in a subject, B : Talo-1st metatarsal angles in AP view in a subject, C : Talo-calcaneal angles in AP view in a subject

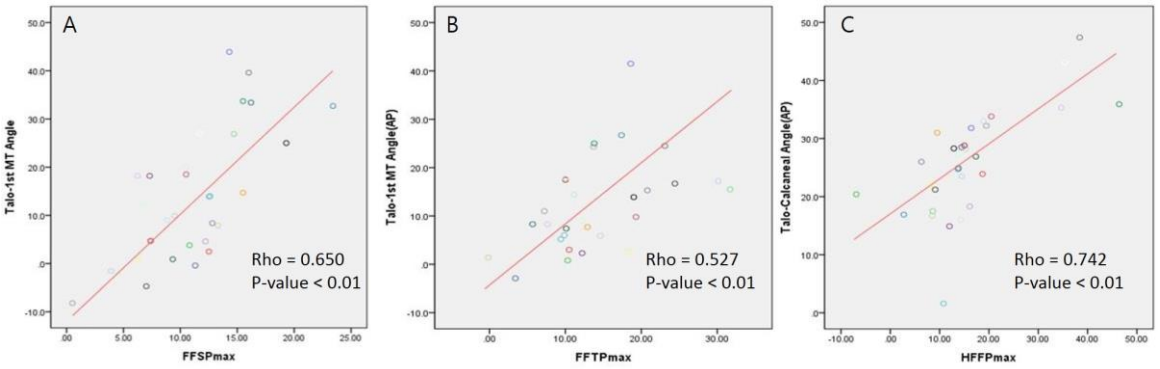

Figure 2. A : Scatter plot of Talo-1st MT Angle and value of FFSP max, B : Scatter plot of Talo-1st MT Angle(AP) and value of FFTP max, C : Scatter plot of Talo-Calcaneal Angle(AP) and value of HFFP max