Inter-segmental foot motions in children and adolescents using a three-dimensional multi-segment foot model

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Dong Yeon Lee

My disclosure is in the Final AOFAS Mobile App. I have no potential conflicts with this presentation.
Introduction

• Several multi-segmental foot models (MFM) have been introduced for the in vivo analysis of dynamic foot kinematics.  
  (Stebbins et al., Gait Posture, 2006)

• Normal range of gait pattern in normal children and adolescents has not yet well established.  
  (Stansfield. et al. JPO, 2001)

• Purpose
  - to suggest normal foot kinematics of clinically normal children and adolescents using three dimensional multi-segment foot model (3D MFM)
Method

• Population
  - 115 healthy children and adolescents
    (M:F=57:58, avg 11.4, 7-17)
  - Only right side was selected

• Divided into two groups
  - Prepuberty group (age 7-10)
  - Puberty group (age 11-17)
OrthoTrak Foot3D Model

- Reflective markers
  - Foot & Lower leg
  - Double sided tape to attach

<table>
<thead>
<tr>
<th>Marker name</th>
<th>Placement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heel</td>
<td>Bisect the posterior aspect of the calcaneus at the height of toe marker</td>
</tr>
<tr>
<td>Distal</td>
<td>Bisect the posterior aspect of the calcaneus below the heel marker and above the fat pad</td>
</tr>
<tr>
<td>Navicula</td>
<td>The most prominent point of the navicula</td>
</tr>
<tr>
<td>Cuboid</td>
<td>Proximal and superior to the base of the 5th metatarsal</td>
</tr>
<tr>
<td>MTH1</td>
<td>On the shaft of the first metatarsal just proximal to the metatarsophalangeal joint break</td>
</tr>
<tr>
<td>Toe</td>
<td>In the space between the 2nd and 3rd metatarsals just proximal to the metatarsophalangeal joint break</td>
</tr>
<tr>
<td>MTH5</td>
<td>On the shaft of the fifth metatarsal just proximal to the metatarsophalangeal joint break</td>
</tr>
<tr>
<td>Hallux</td>
<td>In the Middle of the nail bed</td>
</tr>
</tbody>
</table>
## Result

- Demographic data and temporal gait parameters (mean± SD)

<table>
<thead>
<tr>
<th></th>
<th>Boys</th>
<th>Girls</th>
<th>P value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prepuberty (N=23)</td>
<td>Puberty (N=34)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (yr)</td>
<td>8.7 ± 1.0</td>
<td>13.6 ± 1.9</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Speed (cm/sec)</td>
<td>117.6 ± 12.0</td>
<td>122.7 ± 11.2</td>
<td>0.106</td>
<td></td>
</tr>
<tr>
<td>Stride length (cm)</td>
<td>112.0 ± 10.5</td>
<td>128.0 ± 11.0</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Proportion of stance phase (%)</td>
<td>60.1 ± 1.4</td>
<td>59.8 ± 1.5</td>
<td>0.381</td>
<td></td>
</tr>
</tbody>
</table>
Result
Result

- Both boys and girls in puberty showed approximately 4.5 degrees greater big toe motion in sagittal plane than in prepuberty.

- There were significant difference in sagittal, coronal and transverse plane in forefoot motion between prepuberty and puberty girl, but did not show significant difference in boys.

- Sagittal plane of hindfoot motions increased in both boys and girls in puberty and coronal plane hindfoot motion showed increased pronation in puberty.
Discussion

• Our study suggest that sagittal motion of the great toe manly involves plantar flexion and increase in hallux valgus angle is evidently greater in females than in males throughout growth development.

• Increase in sagittal plane motion and valgus angle often big toe rapidly increased in puberty, while increase in sagittal motion of forefoot and hindfoot were gradual.

• Limitation
  - Need the more large number of normal population
  - Need longitudinal follow up data from the same population
Conclusion

- We present children's normal gait pattern and especially, difference between boys and girls and changes according to age groups.

- Our data can be used as a reference data for assessing the pathological gait patterns and the outcome of treatment.
References


