Tripod Index Part 1:
New radiographic parameter assessing foot alignment

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My disclosure is in the Final AOFAS Program Book.

I and co-authors have no potential conflicts with this presentation.
Introduction

- Several radiographic parameters exist to assess complex foot deformities.

- None of them take into account the whole foot alignment with integrated deformities at multiple planes and levels into a simple measurement.

- Tripod Index (TI) has been created to allow assessment of complex foot deformities utilizing the relationship between center of the heel, medial/lateral borders of the forefoot, and center of the talar head on a standing anteroposterior radiograph.
AIM

- Develop new AP radiographic parameter of the foot (Tripod Index) to assess overall foot alignment.
- Analyze the relationship between this new parameter and other accepted radiographic measurements and physical examination.
  - Compare flatfoot and cavovarus deformity with a control group in adults.
Materials and Methods

- Study population: 3 groups (June 2010 – May 2011)
  Group I: flatfoot deformity (30 feet)
  Group II: cavovarus foot deformity (30 feet)
  Group III: control group, patients without clinically apparent foot and ankle deformity (60 feet)

- Radiographic studies: AP with horse shoe marker around heel, lateral, hindfoot alignment\(^1\) weight bearing views

- Physical examination (subjective hindfoot alignment)
  valgus +2, slightly valgus +1, neutral 0, slightly varus -1, varus -2

Measurement of Tripod Index

A = center of heel (center of horse shoe marker)
B = medial most of medial sesamoid of 1st MTB
C = lateral most of 5th metatarsal head
D = center of talar head
E = tripod angle created by intersection of AB and AC
F = angle created by intersection of AB and AD

Tripod index (%) = \( \frac{F}{E} \times 100 \)

If the AD line is medial to AB line, the index is positive, but if the AD line is lateral to AB line, the index is then negative. The more positive the tripod index, the more the center of the talar head is medial to the tripod of the foot as commonly seen in flatfoot deformity.
Case demonstration

Cavovarus
Tripod index = -108 %

Control
Tripod index = +18 %

Flatfoot
Tripod index = +70 %
Intraclass correlation coefficients (ICC(3,1)) were calculated to determine intrarater and interrater reliability for all of the radiographic parameters measured.

### Intrarater and Interrater ICC values for radiographic parameters

<table>
<thead>
<tr>
<th>Radiographic parameters</th>
<th>Intra rater</th>
<th>Interrater</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tripod Index</td>
<td>0.99</td>
<td>0.98</td>
</tr>
<tr>
<td>AP talonavicular coverage angle</td>
<td>0.93</td>
<td>0.85</td>
</tr>
<tr>
<td>Lateral talo-1st metatarsal angle</td>
<td>0.96</td>
<td>0.69</td>
</tr>
<tr>
<td>Calcanéal pitch angle</td>
<td>0.95</td>
<td>0.98</td>
</tr>
<tr>
<td>Lateral talo-calcanéal angle</td>
<td>0.83</td>
<td>0.71</td>
</tr>
<tr>
<td>Medial cuneiform-5th MTB Height</td>
<td>0.99</td>
<td>0.99</td>
</tr>
<tr>
<td>Coronal plane tibio-calcanéal alignment</td>
<td>0.98</td>
<td>0.95</td>
</tr>
</tbody>
</table>

The following classification scheme is used for ICC: less than 0.40 = poor; 0.40-0.59 = fair; 0.60-0.74 = good; greater than 0.74 = excellent.

Pearson correlation coefficients: correlations between Tripod Index, other radiographic parameters, and physical examination.

In flatfoot group, the TI significantly correlated with the AP talonavicular coverage angle (r = 0.43), medial cuneiform-fifth metatarsal height (r = -0.59), coronal plane hindfoot alignment (r = 0.53), and clinical hindfoot alignment (r = 0.39).

In cavovarus foot group, the TI correlated significantly with the AP talonavicular coverage angle (r = 0.77), calcaneal pitch angle (r = 0.39), medial cuneiform-fifth metatarsal height (r = -0.65), coronal plane hindfoot alignment (r = 0.55), and clinical hindfoot alignment (r = 0.61).
## Results

The differences between 3 groups were assessed with Tukey-Kramer technique-adjusted ANOVA.

<table>
<thead>
<tr>
<th>Radiographic Parameters and Subjective assessment for Control (Con), Flatfoot (Flat), and Cavovarus foot (Cavo) Groups</th>
</tr>
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<td><strong>Coronal plane hindfoot alignment</strong></td>
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<tr>
<td><strong>Subjective assessment of hindfoot alignment</strong></td>
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</tbody>
</table>

Data reported as mean ± standard deviation. The number in the parenthesis in the column headers indicated the number of subjects tested. Statistical significant set at p < 0.05.
The Tripod Index was demonstrated to be a valid and reliable radiographic measurement to quantify the magnitude of complex foot deformities when evaluating flatfoot and cavovarus foot deformity.