Comparison Between Weight Bearing Radiographs and Weight Bearing ConeBeam CT Examinations in the Assessment of Adult Acquired Flatfoot Deformity

C Cesar Netto MD, PhD; S Demehri MD; F Lintz MD; L Fonseca MD; Chinanuvathana MD; L Schon MD.

Medstar Union Memorial Hospital
Johns Hopkins University
Baltimore, MD
Disclosures

• The author(s) declare the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article:
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Adult Acquired Flatfoot Deformity (AAFD)

- Adult acquired flatfoot deformity (AAFD) represents a biomechanical derangement involving the three-dimensional (3D) midfoot and hindfoot osseous complex, and can be challenging to optimally characterize using conventional two-dimensional (2D) plain radiographs.
Study Objectives

- Weightbearing (WB) ConeBeam CT (CBCT) can better demonstrate the deformity of the 3D structures during WB.

- Therefore, we compared validated AAFD measurements between WB conventional radiographs and WB CBCT images.
Methods

• In this IRB approved prospective study we recruited consecutive patients between October 2014 and October 2015.

• Enrollment criteria included:
  – Clinical diagnosis of symptomatic and flexible AAFD (stages 1 and 2).
  – Agreement to cooperate.
  – Signed informed consent.

• Exclusion criteria included:
  – Inability to bear weight.
  – Standard contra-indications for CT imaging.
Methods

- A total of 20 patients with flexible AAFD were included.

- 12 males and 8 females, with a mean age 54.2 years (range, 20-88 years).

- All patients underwent conventional WB radiographs and standing WB CBCTs.

- Images were assessed with traditional AAFD measurements obtained at sagittal (lateral view on radiograph) and axial (anteroposterior view on radiograph) planes using predefined anatomical landmarks, by two independent and blinded foot and ankle board-certified observers.
Results
Measurement Examples

Conventional WB Radiograph

Talar-1st Metatarsal Angle: 18.20°
Naviculo-Medial Cuneiform Angle: 12.49°

WB CBCT

Talar-1st Metatarsal Angle: 24.61°
Naviculo-Medial Cuneiform Angle: 12.49°
Talonavicular Uncoverage Angle: 24.61°
Results

- We found **good to excellent intra and inter-observer agreements for most of the measurements** on both radiographs and WB CBCT images, with slightly better results favoring WBCT measurements.

- When comparing WB radiographs and WB CBCT images, we found significant differences in the mean values for some of the measurements, including:
  - Talus-first metatarsal angle in the sagittal plane (11.34° vs 21.73°, p<0.0001),
  - Navicular-medial cuneiform angle (13.19° vs 7.63°, p<0.0004)
  - Medial cuneiform to floor distance (6.70mm vs 5.50mm, p<0.0003)
  - Navicular to floor distance (31.34mm vs 23.22mm, p<0.0001)
### Results
#### Sagittal View Measurements

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<tr>
<td>Talar-1&lt;sup&gt;st&lt;/sup&gt; Metatarsal Angle</td>
<td>0.8520</td>
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<td>(Sagittal/Lateral View)</td>
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<td>Talar-1&lt;sup&gt;st&lt;/sup&gt; Metatarsal Angle</td>
<td>0.3512</td>
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<td>(Axial/AP View)</td>
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<td>Medial Cuneiform-1&lt;sup&gt;st&lt;/sup&gt; Metatarsal Angle</td>
<td>0.2392</td>
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<tr>
<td>Navicular-Medial Cuneiform Angle</td>
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<tr>
<td>Navicular to Floor Distance</td>
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<td>Medial Cuneiform to Floor Distance</td>
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<td>Cuboid to Floor Distance</td>
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<tr>
<td>Talonaviucular Uncoverage Angle</td>
<td>0.9101</td>
<td>0.978</td>
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Results

• No significant differences were found when measuring:
  – Talus-first metatarsal angle in the axial plane
  – Talar uncoverage angle
  – Cuboid to floor distance
  – Calcaneal inclination angle
Conclusions

- Traditional adult acquired flatfoot deformity radiographic measurements are obtainable using high resolution 3D WB CBCT imaging.

- Measurements performed on WB CBCT have similar intra-observer and overall higher inter-observer reliability when compared to WB radiographs.

- The statistically significant differences found in some of the measurements, when comparing both imaging techniques, might be related to a better characterization of the three-dimensional deformity on WB CBCT images.