Radiographic measurements associated with the natural progression of the hallux valgus deformity during at least two years of follow-up

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Introduction

• Hallux valgus is one of the most common foot deformities and expected to increase in the future with the aging society.

• Studies regarding quantitative progression of hallux valgus deformity and the effects of the potential risk factors on progression of the deformity in adults of prevalent ages are lacking.
Introduction & Purpose

• There is a lack of information regarding the progression of hallux valgus and radiographic measurements.

• Therefore, we performed this study to investigate the radiographic measurements associated with the progression of hallux valgus deformity during at least two years of follow-up.
Materials and Methods

- IRB approved retrospective study

- **Inclusion**
  - HVA 15 degrees or more.
  - Underwent repeated radiographs with at least 2-year intervals

- **Exclusion**
  - Patients with comorbidity affecting foot appearance
  - Undergone prior foot surgery
  - Inadequate radiographs available for review

- **Final Inclusion**: A total of 70 feet of 70 patients

  - **Progressive group** (18 patients)
    - 5 degrees or more during follow-up
  
  - **Non-Progressive group** (52 patients)

Compared between the two groups
Materials and Methods

Radiographic measurements

- The eight indicies
  - HVA (Hallux valgus angle)
  - HIA (Hallux interphalangeal angle)
  - IMA (Intermetatarsal angle)
  - MAA (Metatarsus adductus angle)
  - DMAA (Distal metatarsal articular angle)
  - TSP (Tibial sesamoid position)
  - AP talo-first metatarsal angle
  - Lat talo-first metatarsal angle
## Results

### Table 1. Data summary.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Progressive group</th>
<th>Non-progressive group</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of subjects</td>
<td>18 (9.7)</td>
<td>52 (12.7)</td>
<td>0.029</td>
</tr>
<tr>
<td>Age at initial visit (years)</td>
<td>63.9 (4.7)</td>
<td>55.9 (5.6)</td>
<td>0.728</td>
</tr>
<tr>
<td>Male : Female</td>
<td>4 : 14</td>
<td>9 : 43</td>
<td>0.785</td>
</tr>
<tr>
<td>Right : Left</td>
<td>8 : 10</td>
<td>27 : 25</td>
<td>0.297</td>
</tr>
<tr>
<td>Follow-up duration (months)</td>
<td>54.0 (25.6)</td>
<td>46.4 (18.3)</td>
<td></td>
</tr>
<tr>
<td>Initial radiographs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HVA</td>
<td>28.9 (7.6)</td>
<td>24.0 (5.8)</td>
<td>0.010</td>
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<tr>
<td>HLA</td>
<td>6.7 (5.8)</td>
<td>10.4 (5.6)</td>
<td>0.033</td>
</tr>
<tr>
<td>IMA</td>
<td>12.4 (3.4)</td>
<td>11.3 (3.0)</td>
<td>0.258</td>
</tr>
<tr>
<td>MAA</td>
<td>21.6 (4.4)</td>
<td>20.5 (4.9)</td>
<td>0.462</td>
</tr>
<tr>
<td>DMAA</td>
<td>30.6 (12.6)</td>
<td>21.6 (9.7)</td>
<td>0.065</td>
</tr>
<tr>
<td>Tibial sesamoid position (Gr 0/1/2/3)</td>
<td>1/4/5/8</td>
<td>5/9/25/13</td>
<td>0.334</td>
</tr>
<tr>
<td>AP talo-1&lt;sup&gt;st&lt;/sup&gt; metatarsal angle</td>
<td>13.6 (7.5)</td>
<td>7.9 (6.7)</td>
<td>0.011</td>
</tr>
<tr>
<td>Lateral talo-1&lt;sup&gt;st&lt;/sup&gt; metatarsal angle</td>
<td>6.3 (6.7)</td>
<td>6.1 (6.8)</td>
<td>0.894</td>
</tr>
<tr>
<td>Final radiographs</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>HVA</td>
<td>36.8 (7.7)</td>
<td>25.4 (6.1)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>HLA</td>
<td>6.1 (6.4)</td>
<td>9.5 (6.4)</td>
<td>0.078</td>
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<tr>
<td>IMA</td>
<td>14.6 (2.9)</td>
<td>11.7 (2.9)</td>
<td>0.003</td>
</tr>
<tr>
<td>MAA</td>
<td>22.7 (4.9)</td>
<td>20.5 (4.3)</td>
<td>0.108</td>
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<tr>
<td>DMAA</td>
<td>37.2 (11.6)</td>
<td>23.6 (10.3)</td>
<td>0.002</td>
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<tr>
<td>Tibial sesamoid position</td>
<td>0/1/4/13</td>
<td>4/7/16/25</td>
<td>0.273</td>
</tr>
<tr>
<td>AP talo-1&lt;sup&gt;st&lt;/sup&gt; metatarsal angle</td>
<td>12.3 (7.4)</td>
<td>8.6 (5.8)</td>
<td>0.081</td>
</tr>
<tr>
<td>Lateral talo-1&lt;sup&gt;st&lt;/sup&gt; metatarsal angle</td>
<td>7.9 (7.6)</td>
<td>8.3 (8.6)</td>
<td>0.864</td>
</tr>
</tbody>
</table>

- **Progressive group** (18 patients)
- **Non-Progressive group** (52 patients)
- 5 degrees or more during follow-up
- Compared between the two groups
Results

The initial DMAA (p=0.027) and initial AP talo-first metatarsal angle (p=0.034) were found to be significant factors associated with the progression of hallux valgus deformity.
Results

A change in the HVA was significantly correlated with changes in the IMA (r=0.423; p=0.001) and DMAA (r=0.541; p<0.001).

A change in the IMA was significantly correlated with a change in the DMAA (r=0.294; p=0.019).

A change in the DMAA was significantly associated with changes in the TSP (r=0.311; p=0.013) and the lateral talo-first metatarsal angle (r=0.372; p=0.004).
Discussion

• Progression of HVA significantly correlated
  – Initial DMAA & initial AP talo-first metatarsal angle
  – Changes in the IMA and DMAA
  – Special attention needs to pes planus and increased DMAA during follow-up
Discussion

• AP talo-first metatarsal angle associated with progression of hallux valgus
  – Abduction force exerted on the forefoot
  – HV deformity progression is usually concurrent with metatarsus primus varus deformity (decreases the AP talo-first metatarsal angle)
  – More accurate 3D evaluation are required
Discussion

- DMAA is increased in hallux valgus deformity
  - Joint surface remodeling
  - First metatarsal head pronation
    - Concurrent with an unstable first tarsometatarsal joint
    - Change in IMA was significantly correlated with change in DMAA
    - More attention should be given to the stabilization of the first tarsometatarsal joint