Minimally Invasive Distal Linear Metatarsal Osteotomy for Correction of Hallux Valgus: Clinical Outcome and Analytical Radiographic Results via a Mapping System


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My disclosure is in the Final AOFAS Program Book. I have no potential conflicts with this presentation.
Introductions

- Technical challenges and possible complications of the conventional osteotomies in hallux valgus have inspired surgeons to develop less invasive methods with presumably diminished morbidities, complications, and operation time.

- **DLMO**: Distal Linear Metatarsal Osteotomy was developed by Inokuchi S, in 2003*.

- Actual results of DLMO via more explicit radiographic delineation are poorly understood and radiographic findings and clinical results have not been systematically correlated.

- Purposes of this study
  1. To evaluate the effectiveness of DLMO using a precise radiographic mapping system**
  2. To determine the relationship between radiographic outcomes and clinical results, including related complications.

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*Inokuchi S. J Jpn Orthop Assoc 2003
Patients and Methods

• **Timing**: Between January 2008 and December 2011

• **Population & Intervention**:
  -- Inclusion criteria: all levels of severity (mild-to-severe) with reducible deformity (correctable alignment of hallux valgus by manual reduction) at the preoperative assessment, no hypermobility or arthritic conditions.
  -- DLMO was performed on a total of 30 patients (36 feet)
  -- Mean age: 59 years (range, 16 to 86 years).
  -- Mean time at final follow-up: 10 months (range, 3 to 29 months).

• **Comparison**: Pre-and-postoperative data

• **Outcomes**: clinical (AOFAS, complications), radiographic (conventional measurements, mapping system), correlation between clinical and radiographic outcomes.
Each point was located digitally using the digital Picture Archiving and Communication System (PACS) as both figures. The precision of this measure technique using the mapping system has been reported by Tanaka and colleagues*.

Results: Conventional Measurements

Preoperative evaluation:
- Two patients (5.6%) --mild; 26 (72.2%) --moderate; eight (22.2%) --severe via HVA definition.
- Seven patients (19.4%) --mild; 23 (63.9%) --moderate; six (16.7%) --severe via IMA definition.
• The HVA, IMA and DMAA at final postoperative follow-up were significantly lower compared with preoperative values.
• Nine feet (25%) were observed with recurrence of deformity which showed HVA>15 degrees.

<table>
<thead>
<tr>
<th>Angle</th>
<th>Preoperative value (degrees)</th>
<th>Postoperative value (degrees)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVA</td>
<td>32.3 ± 8.2</td>
<td>10.3 ± 7.5</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>IMA</td>
<td>14.2 ± 4.0</td>
<td>7.1 ± 2.7</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>DMAA</td>
<td>34.4 ± 10.6</td>
<td>7.1 ± 8.0</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>
### Results: Mapping System

<table>
<thead>
<tr>
<th>Point</th>
<th>Preoperative value (mm)</th>
<th>Postoperative value* (mm)</th>
<th>p-value (X, Y)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X coordinate</td>
<td>Y coordinate</td>
<td></td>
</tr>
<tr>
<td>DPB1</td>
<td>104.1 ± 11.2</td>
<td>16.0 ± 4.2</td>
<td>0.023, &lt;0.001</td>
</tr>
<tr>
<td>PPB1</td>
<td>77.8 ± 7.0</td>
<td>24.8 ± 3.1</td>
<td>&lt;0.001, 0.002</td>
</tr>
<tr>
<td>MH1</td>
<td>75.3 ± 8.0</td>
<td>29.8 ± 3.7</td>
<td>&lt;0.001, &lt;0.001</td>
</tr>
<tr>
<td>LS</td>
<td>61.1 ± 6.9</td>
<td>12.6 ± 1.9</td>
<td>0.347, &lt;0.001</td>
</tr>
<tr>
<td>MS</td>
<td>64.2 ± 7.6</td>
<td>28.6 ± 3.8</td>
<td>&lt;0.001, 0.004</td>
</tr>
<tr>
<td>MB1</td>
<td>13.8 ± 2.4</td>
<td>17.0 ± 1.3</td>
<td>0.001, 0.845</td>
</tr>
<tr>
<td>MH2</td>
<td>77.8 ± 7.4</td>
<td>0</td>
<td>Not significant, -</td>
</tr>
</tbody>
</table>

- AP mapping system revealed a significant medial reposition of the distal phalangeal base (DPB1) and a significant reduction of the 1\textsuperscript{st} to 2\textsuperscript{nd} intermetatarsal area (lateral reposition of PPB1, MH1) in the mediolateral plane as figure/table shown. The medial/lateral sesamoids shifted laterally compared with their preoperative location.
- Lateral mapping system showed 24 feet (66.7\%) presented with postoperative malalignment or malunion; 10 feet had dorsiflexion malunion and 14 feet had plantarflexion malunion.
Results: Clinical Evaluation

• **AOFAS scores**: Mean postoperative (final follow-up) AOFAS scores were significantly higher than the mean preoperative AOFAS scores (95 ± 6.4 versus 70.2 ± 11.3; \( p < 0.001 \)).

• **Correlations** between AOFAS scores & radiographic outcomes

  1. The improvements in all angular measurements were significantly associated with improvements in the AOFAS score (\( p < 0.001 \)).

  2. The postoperatively radiographic abnormalities (malunion, recurrence, sesamoid lateralization) were not related to clinical outcomes including postoperative AOFAS scores (\( p > 0.05 \)).

• **Complications**

  - No complications such as pin tract infection, deep infection, nonunion, hallux varus, joint stiffness, transfer metatarsalgia or avascular necrosis of the capital fragment were observed in all patients in this study.
Discussion & Conclusion

- DLMO is a reliable procedure to correct reducible hallux valgus in patients with all severities, especially on mild-moderate severity.

- Sagittal malunion, radiographic recurrence, and sesamoid lateralization are possibly radiographic abnormalities but are not associated with clinical impairments.
References


Komeda, T; Tanaka, Y; Takakura, Y; Fuji, T; Samoto, N; Tamai, S: Evaluation of the longitudinal arch of the foot with hallux valgus using a newly developed two-dimensional coordinate system. J Orthop Sci. 6:110–118, 2001.


Tanaka, Y; Takakura, Y; Sugimoto, K; et al: Precise Anatomic Configuration Changes in The First Ray of Hallux Vagus Foot. Foot Ankle Int. 21:651-6, 2000.