Dilemma in Severity Classification of Incongruent Hallux Valgus Deformity Using Radiological Measurements

Il-Hoon Sung, M.D., Kyung-Tai Lee, M.D.*, Ki-Won Young, M.D.*, Kuhn-Sung Whang, M.D., Choong-Hyeok Choi, M.D., Jae-Hong Jung, M.D., and Min-Hoi Koo, M.D.

Department of Orthopaedic Surgery, College of Medicine, Hanyang University, Seoul; Department of Orthopaedic Surgery, Eulgi University College of Medicine*, Seoul, Korea

Purpose: To study the availability of the radiological classification for incongruent hallux valgus deformities, which has been used as the key to the algorithm for selecting surgical options.

Materials and Methods: To determine radiological severity, 257 cases of incongruent hallux valgus deformities were studied. The hallux valgus angle (HVA) and the 1/2 intermetatarsal angle (IMA) were measured in each case. Following Mann's radiological classification system, the HVA and IMA were compared to determine any similarity in severity. The distal metatarsal articular angle (DMAA) was also measured to observe the extent of its effect on the incongruent deformity.

Results: The HVA was 36.1° on average (range, 16-60°) and the 1/2 IMA was 15.8° on average (range, 5-30°). In 126 cases (49.1%), the severity between the 1/2 IMA and HVA coincided with the index classification, whereas 131 cases (50.9%) did not correspond. Overall, the severity of approximately half the cases, could not be graded. The DMAA was 15.6° on average (range, 0-40°) and 133 cases (51.8%) demonstrated a value above normal value (>15°).

Conclusion: The radiological classification system used as a guide for surgical decision-making needs to be revised, due to the overt limits of correspondence between the severity of the 1/2 IMA and HVA. Because the HVA would be influenced by both the lateral subluxation and bony deformity around the first metatarsophalangeal joint, it is reasonable to consider these factors on the HVA as elements to be corrected individually, instead of the HVA alone.

Key Words: Incongruent hallux valgus, Radiological classification
incongruency of the first metatarsophalangeal (MP) joint. Cases with inflammatory disease, degenerative changes of the MP joint, or instability of the first tarsometatarsal joint, were excluded. 257 cases were selected and the average age was 44.6 years old (range; 20-65 years old). The HVA, 1/2 IMA, and distal metatarsal articular angle (DMAA) were measured from a weight-bearing anteroposterior radiographic view of the foot by one of the authors (KWY).

Incongruency of the first MP joint was defined by Coughlin’s criteria\(^5\). That is, the articular midpoints of the two lines extending from the most medial side to the most lateral side of the metatarsal head and proximal phalangeal base, do not coincide with each other. The HVA was defined as the angle between each longitudinal axis of the first metatarsal bone and proximal phalanx. According to Hardy and Clapham\(^10\), the 1/2 IMA was measured from the longitudinal axes of the first and second metatarsal bones. We classified the severity of the HVA and 1/2 IMA in each case, by the method proposed by Mann (Table 1). We also examined cases with DMAA greater than 15°, which exceeded the average\(^14\), to observe their distribution on the incongruent deformity. The DMAA was measured between the line extending the medial side to the lateral side of the articular surface of the first metatarsal head and the longitudinal axis of the first metatarsals, according to Smith et al.\(^25\).

To investigate the relationship between the 1/2 IMA and HVA and also analyze if the severity of the 1/2 IMA would correspond to that of the HVA, the relation coefficient and Kappa index (\(\kappa\)-index) were calculated.

**RESULTS**

The HVA was 36.1° on average (range, 16-60°) and the

---


![Algorithm for decision-making in hallux valgus surgery](image-url)
1/2 IMA was 15.8° on average (range, 5-30°). Based on Mann’s standard of radiological classification, in 126 cases (49%), the severity of the HVA coincided with that of the 1/2 IMA, whereas, in 131 cases (51%) it did not (Table 2). The relation coefficient between the HVA and 1/2 IMA was 0.22 and the $\varepsilon$-index was 0.2 which meant that the two angles do not correlate well. The DMAA was 15.6° on average (range, 5-30°). Based on this process, in 126 cases (49%), the severity of the HVA coincided with that of the 1/2 IMA, whereas, in 131 cases (51%) it did not (Table 2).

**Table 2. Number of patients, according to severity of HVA and IMA**

<table>
<thead>
<tr>
<th></th>
<th>Mild IMA</th>
<th>Moderate IMA</th>
<th>Severe IMA</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild HVA</td>
<td></td>
<td></td>
<td></td>
<td>50</td>
</tr>
<tr>
<td>mean HVA: 25.0° (range, 23-29°)</td>
<td>23</td>
<td>24</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>mean IMA: 10.8° (range, 5-13°)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate HVA</td>
<td></td>
<td></td>
<td></td>
<td>106</td>
</tr>
<tr>
<td>mean HVA: 32.9° (range, 30-39°)</td>
<td>17</td>
<td>77</td>
<td>12</td>
<td>106</td>
</tr>
<tr>
<td>mean IMA: 11.7° (range, 7-3°)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe HVA</td>
<td></td>
<td></td>
<td></td>
<td>101</td>
</tr>
<tr>
<td>mean HVA: 45.6° (range, 40-58°)</td>
<td>8</td>
<td>67</td>
<td>26</td>
<td>101</td>
</tr>
<tr>
<td>mean IMA: 12.3° (range, 11-13°)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sum</td>
<td>48</td>
<td>168</td>
<td>41</td>
<td>257</td>
</tr>
</tbody>
</table>

HVA, Hallux Valgus Angle (15° < Mild < 30°, 30 ≤ Moderate < 40°, Severe ≥ 40°). IMA, Intermetatarsal Angle (9° < Mild < 14°, 14° ≤ Moderate < 20°, Severe ≥ 20°).

**Table 3. Proposed Algorithm for decision-making in hallux valgus surgery**

1. **Distal soft tissue procedure**
2. **Metatarsal osteotomy**: (Large 1, 2 IMA)
3. **Metatarsus primus varus**: (Large DMAA and/or PPAA)
4. **Wedge osteotomy**

*; Intra or extra-articular release for the lateral ligament complex could be selected, depending on the site of metatarsal osteotomy or surgeon’s preference. (The extra-articular release is generally recommended when the proximal osteotomy is performed). **; IMA, intermetatarsal angle; †; distal and/or proximal metatarsal osteotomy could be selected, depending on severity of 1, 2 IMA (The distal metatarsal osteotomy is generally recommended on mild to moderate (<15°) severity and the proximal metatarsal osteotomy on moderate to severe (>15°) severity). ‡; MP, metatarsophalangeal; †; DMAA, distal metatarsal articular angle; ‡; PPAA, proximal phalangeal articular angle. **; Closed wedge osteotomy on the 1st metatarsal and/or proximal phalanx could be planned, depending on severity of DMAA and PPAA (It is generally recommended that the wedge osteotomy would be done for cases with more than 15° of DMAA or PPAA).

**DISCUSSION**

To select the most appropriate surgical options for various types and degrees of severity of the hallux valgus deformities, Mann17-19 and Alexander20 presented separate algorithms according to criteria based on both radiological and clinical findings. In Alexander’s clinical classification system, the criteria could not be objectively quantified, and there was no specific reference to the deformity of bony structures around the MP joint. These are drawbacks of the classification system, which explain why it has not been used widely. Mann’s classification was based largely on radiological findings and angular parameters, including the HVA and 1/2 IMA19. In particular, in cases with an incongruent deformity of the MP joint, the ultimate degrees of severity of the hallux valgus deformities are described as mild, moderate and severe, which are determined by combining the severity of each of those two angles. Then, appropriate surgical options were offered for each of the deformities, based on this process (Table 1). Overall, this process of this classification makes it somewhat complex to determine the actual severity, because a combination of the degrees of severity is required even after determining the severity of each of those two angles independently. According to our study, the HVA and 1/2 IMA did not correlate very well and the
classification method itself could be applied to only half of those cases, because of the discrepancies of the degrees of severity among the groups. Therefore, this mismatch-up between HVA and 1/2 IMA might give difficulty to make the proposed surgical decision, using this classification method. Reliability of measurement of the HVA and 1/2 IMA has been reported in many studies\textsuperscript{5,24}. Parts of the mismatch between the severity of the HVA and 1/2 IMA, demonstrated in this study, could be affected by potential errors of measurement and/or the given ranges of severity of the HVA and 1/2 IMA. We believe that a certain proportion of this mismatch would be somewhat extent in any instance. The purpose of this study was not to evaluate which classification method would be without error in determining the severity of hallux valgus deformities, but to evaluate the validity of the algorithms themselves for selecting the appropriate surgical options. The HVA would represent the lateral angulation of the hallux relative to the first metatarsal bone. This angular malposition of the hallux to the first metatarsal bone on the first MP joint could be result from the subluxation of the first MP joint and/or bony deformities around the first MP joint, or a combination of the two. We believe that to select the appropriate surgical option, those contributing variables should be defined separately. In other words, those two variables that affect the HVA and contribute significantly to the deformity, should be corrected independently with different surgical methods.

In cases with incongruent deformities, the subluxation of the first MP joint is regarded as an important element which should be treated by a distal soft tissue procedure. With the distal soft tissue procedure, congruency of the first MP joint can be achieved. Whereas, bony deformities around the first MP joint, including an increased DMAA and/or PPAA, would be corrected by, a wedge osteotomy, if it is large enough\textsuperscript{22}. In this study, half of the cases had a large DMAA, which was greater than the average value. From this, it is assumed that bony deformities would not insignificantly contribute to the severity of incongruent hallux valgus deformities. However, additional studies are needed to improve the reproducibility of the DMAA due to poor inter- and intra-observer reliability for measuring this angle\textsuperscript{14}. In addition to the above two variables which affect the size of the HVA, a large 1/2 IMA would be a major part of a hallux valgus deformity which should be corrected with a surgical procedure, namely, shifting the first metatarsal toward the second one, such as with a distal or and proximal metatarsal osteotomy, or both\textsuperscript{15,16,18}.

Considering these points collectively about in incongruent hallux valgus deformities without the arthritis or instability, a simple algorithm for surgical decision-making could be developed, using the above three variables (Table 3). We suppose that presented algorithm would be undemanding to be used and also include every possible index, to improve the alignment status of the first ray in incongruent hallux valgus deformity.

**CONCLUSION**

To use radiological classification as a guide for surgical decision-making in hallux valgus deformities, it is not reasonable to use both the HVA and 1/2 IMA simultaneously. This classification needs to be revised, due to the overt limits of the discrepancy between the severity of the HVA and 1/2 IMA. Because the HVA would be influenced from both the lateral subluxation and bony deformity around of the first MP joint as well, it is reasonable to consider these influencing factors on the HVA as elements to be corrected individually instead of just the HVA alone.

**REFERENCES**

9. Goldberg I, Bahar A and Yosipovitch Z: Late result after cor-


목적: 비상합성 무지 외반증의 수술 계획 수립을 위해 기존에 사용되던 각도 계측에 의한 분류법의 유용성을 재고찰하고자 한다.

대상 및 방법: 비상합성 무지 외반증 257예를 연구 대상으로 하여 이들의 무지 외반각과 제1-2 중족골간 각을 측정하였다. Mann에 의한 방사선적 계측에 따른 분류 방법으로 무지 외반각과 제1-2 중족골간 각 사이의 중증도를 비교하였고, 이들의 중증도가 서로 일치하는지를 확인하였다. 비상합성 변형의 분포 정도를 관찰하기 위해 원위 중족 관절각 또한 계측하였었다.

결과: 무지 외반각은 평균 36.1° (범위, 16-60°)이었으며 제1-2 중족골간 각은 평균 15.8° (범위, 5-30°)이었다. 무지 외반각과 제1-2 중족골간 각의 중증도가 서로 일치하는 예는 126예(49.1%)이었고 131예(50.9%)에서는 중증도가 일치하지 않았다. 원위 중족 관절각은 평균 15.6° (범위, 0-40°)이었으며 133예(51.8%)에서 정상치 이상(>15°)을 보였다.

결론: 무지 외반각과 제1-2 중족골간 각의 중증도가 서로 일치하지 않는 한계가 있으므로, 수술 방법 결정을 위한 지침으로써 방사선학적 분류를 이용하기 위해서는 기존의 분류 체계가 보완되어야 할 것이다. 무지 외반각은 제1 중족골관절 주변의 골성 변형이나 외측방 아탈구 등에 의해 영향을 받으므로, 무지 외반각에 영향을 미치는 이러한 요소들을 세분하고 이를 교정해야 할 대상으로 고려하여야 할 것으로 사료된다.

색인 단어: 비상합성 무지외반증, 방사선학적 분류

*본 논문의 요지는 2001년도 대한정형외과학회 추계학술대회에서 발표되었음.