First tarsometatarsal joint mobility in hallux valgus: Three-dimensional analysis using weight-bearing computed tomography and its correlation with degree of deformity

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Tadashi Kimura

My disclosure is in the Final AOFAS Mobile App. I have no potential conflicts with this presentation.
**Introduction**

Hypermobility of the first TMT joint in hallux valgus.

**Past studies**

Evaluated only two-dimensionally (2-D)

However...

**Hallux valgus deformity consist of 3-D components**
(including inversion and eversion)

To analyze in detail the first ray mobility

Capture CT images and reconstruct a 3-D model
Purpose of this study

Evaluated mobility of the first TMT joint in 3D using weight-bearing computed tomography (CT) with an original loading device and then examined the correlation between the hallux valgus angle and the intermetatarsal angle (IMA) in hallux valgus patients.
Subjects

Control group

10 feet of 10 volunteers
Excluded
- History of foot disorders
- Foot symptoms
All female
Age: 56±5 (50-66)
HV angle: 14±3 deg.

Hallux valgus group

10 feet of 10 patients
Excluded
- Rheumatism
- Other foot conditions
All female
Age: 58±14 (33-74)
HV angle: 43±10 deg.
Method

Non-weightbearing CT
Lower limbs: Extended
Ankle: Neutral position

Weightbearing CT
Loading subject’s body weight
Feet: Same position

Original loading device
reproduced standing conditions accurately.

3-D models were reconstructed from CT images.
Image analysis

ICP algorithm (Iterative closest point)

Aligned medial cuneiform

Quantified displacement of the first metatarsal relative to the medial cuneiform in 3D under non-weightbearing and weightbearing conditions.

Comparison between two groups.
Displacement of the first metatarsal relative to the medial cuneiform (the first TMT joint)

* P < 0.05

Mobility of the first TMT joint in hallux valgus patients are significantly larger in all three directions than in healthy volunteers.
Correlation between the mobility of the first TMT joint and hallux valgus angle

There was no significant correlation.
Correlation between the mobility of the first TMT joint and the 1-2 intermetatarsal angle (IMA)

There was no significant correlation.
The use of an original loading device enabled a detailed 3-D analysis of changes in the foot.

Hallux valgus patients showed hypermobility of the first TMT joint not only in dorsiflexion (sagittal motion), but also in inversion and adduction.

No significant correlation between the first ray mobility and hallux valgus deformity.
Discussion

Hypermobility of the first TMT joint in hallux valgus.

Leads to the hallux valgus deformity

First TMT joint contracture including the tendon and soft tissue??

Yes No

Decreased mobility of the first TMT joint.

Increased mobility of the first TMT joint.

No significant correlation between the first ray mobility and hallux valgus deformity.

Our technique and findings help to clarify the nature of the pathology of hallux valgus and should assist in the selection and development of treatment methods.