Mobility changes in the first TMT joint after proximal osteotomy for hallux valgus: Evaluation by weightbearing CT and a 3D analysis system

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The authors have nothing to disclose
Our previous study

- 3D analysis system
- Weightbearing CT

Detailed evaluation of mobility of each joint composing the first ray

Hypermobility extends across the entire first ray not only at the TMT joint, but also at other joints that compose the first ray in hallux valgus patients


Displacement was especially pronounced in the first TMT joints, indicating it is the primary cause of first ray hypermobility.
Introduction

We developed a locking plate
✓ For proximal first metatarsal osteotomy
✓ To correct three-dimensionally
  Hallux valgus
  Associated deformity (e.g. flat foot)
Purpose of this study

To evaluate postoperative changes in mobility of the first TMT joints in 3D using weightbearing CT

Subjects

5 feet of 5 patients
Excluded
- Rheumatism
- Other foot conditions
All female
Age: 56 ± 12 years (33-65)
HV angle: 38 ± 10°
Intermetatarsal angle: 23 ± 3°
At 1 to 1.5 years after proximal first metatarsal osteotomy, we performed follow-up CT using the same method.
X-axis = Vector product of line connecting center of the calcaneus with head of the second metatarsal bone and Z-axis

Y-axis = Cross-product of Z-axis and X-axis

Z-axis = Axis of tibia
Pre-op vs Post-op

ICP algorithm (iterative closest point)

Allow superimposition of 3DCT medial cuneiform images, without needing to register anatomical features

Alignment of medial cuneiform

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

Image analysis
Results

H-V angle

Pre-op: 38
Post-op: 10

Intermetatarsal angle

Pre-op: 23
Post-op: 7

JSSF Scale

Pre-op: 62
Post-op: 97

(Japanese Society for Surgery of the Foot Hallux Scale)
There was significant displacement in dorsiflexion, inversion and adduction of the first metatarsal relative to the medial cuneiform between non-weightbearing and weightbearing conditions.

dorsiflexion: $p = 0.02$, inversion: $p = 0.001$, abduction: $p = 0.01$
Discussion

Mobility of the first TMT joint under weightbearing conditions decreased after our surgery

Our surgery aimed to correct hallux valgus and associated pes planus

Correction of orientation and tension of surrounding tendons and ligaments and the plantar aponeurosis

Improved shape of the foot and hypermobility of the first ray

Achieved favorable functional outcomes
We conducted a detailed 3D evaluation of first TMT joint mobility before and after surgery, which has been difficult to evaluate by other methods such as plain radiography.

3D deformity should also be corrected in 3D to achieve a natural shape with proper function of the foot.

Our detailed 3D analysis of the foot offers more accurate assessment of the deformity, helping surgeons choose the most appropriate treatment method.