Mobility Changes in the First TMT Joint after Proximal First Metatarsal Osteotomy for Hallux Valgus Evaluated by Weightbearing CT and a 3D Analysis System

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Introduction/Purpose: In a previous study, we found that feet with hallux valgus show significantly greater three-dimensional mobility than normal feet in all joints of the first ray. Displacement was particularly pronounced in the first TMT joints, indicating that this is the primary cause of first ray hypermobility. We developed a plate used specifically for proximal first metatarsal osteotomy to perform three-dimensional correction of hallux valgus and associated deformities. In this study, we evaluated changes in mobility of the first TMT joints after surgery in 3D using weightbearing CT.

Methods: The subjects were 5 feet of 5 female patients with hallux valgus (mean age 56 years, mean hallux valgus angle 38°). We performed non-weightbearing and weightbearing (using a load equivalent to body weight) CT scans before surgery using an original loading device (Fig a). We reconstructed 3D models from captured images by segmentation and defined axial coordinate system (Fig b). Next, we measured the three-dimensional displacement of the first metatarsal bone relative to the medial cuneiform bone under weightbearing conditions. At 1 to 1.5 years after proximal metatarsal osteotomy for all patients, we performed a follow-up CT scans using the same method and compared preoperative and postoperative displacement. Student’s t-test was performed to statistically compare data and statistical significance was set at p < 0.05.

Results: Postoperatively (when performing a follow up CT), the mean hallux valgus angle improved from 38° to 10° and the mean first-second metatarsal angle improved from 23° to 7°. The mean score on the Japanese Society for Surgery of the Foot hallux scale improved from 62 points to 97 points. Displacement of the first metatarsal bone relative to the medial cuneiform bone between non-weightbearing and weightbearing conditions decreased significantly in all directions, from 4.2° ± 1.8° to 1.6° ± 1.1° of dorsiflexion (p = 0.02), 4.9° ± 1.8° to 0.7° ± 0.9° of inversion (p = 0.001), and 4.4° ± 1.9° to 1.7° ± 0.8° of adduction (p = 0.01).

Conclusion: Displacement of the first TMT joints under weightbearing conditions decreased after our surgery. This indicates that the surgery corrected hallux valgus and associated pes planus and produced favorable functional outcomes by improving the shape of the foot and hypermobility of the first ray through correction of the orientation and tension of surrounding tendons and ligaments and the plantar aponeurosis. In the future, we plan to further examine the pathology and treatment of hallux valgus with a focus on postoperative changes in soft tissue orientation.