HV Patients Show Greater Pronation of the First Metatarsal than Normals
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Introduction/Purpose: The progression of the hallux valgus (HV) deformity demonstrates dorsiflexion and abduction; concomitant pronation has not received adequate documentation and the extent of pronation in the pathology is unknown even though correction of the deformity may need to address all three angles. To overcome the inability of standard radiographs to capture pronation, we have developed a means to assess the three dimensional deformity using CT scans. Our goal was to document the extent of pronation/supination both of the first phalanx with respect to the first metatarsal and of the first metatarsal with respect to the second metatarsal. Furthermore, we wanted to regress pronation against the intermetatarsal (IMA) angle of hallux valgus patients.

Methods: Three-dimensional models were reconstructed from loaded and unloaded CT files of patients (10 HV, 10 normal). The orientations of specific bones, in anatomic directions, were determined by selecting landmarks on the surface of the phalanx and of the first and second metatarsals. The resulting calculations output a set of angles to determine the pronation/supination of the first metatarsal relative to the second and of the first phalanx relative to the first metatarsal. A regression analysis was conducted to extrapolate any relationship between adduction and pronation (known intermetatarsal and pronation).

Results: The average pronation of the first metatarsal relative to the second metatarsal was 19.8 ± 7.1 and 28.3 ± 10.8 in the normal and HV groups respectively (p < 0.05). The influence of weightbearing demonstrated pronation angle differences that were greater in the normal group than in the HV group for both the IM pronation and the HV pronation (p < 0.05) (Figure 1). The differences in HV angles and IM angles between normal and HV patients were 22° and 7° respectively. The regression analysis of the pronation and intermetatarsal angle was not found to be significant, with a weak correlation (r² = 0.26).

Conclusion: The pronation of the first metatarsal relative to the second metatarsal between normal and HV patients is significantly different. While the first metatarsal had measurable pronation in patients with hallux valgus but that value was not predicted by the IMA. The findings of this study indicate pronation should be considered in any surgical technique that seeks to restore native configurations.