

Simulated Weight-Bearing CT Improves Hindfoot Alignment Assessment and Offers an Alternative to True Weight-Bearing CT Scanners

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Purpose: Accurate assessment of hindfoot alignment following calcaneal fractures is critical for guiding surgical and rehabilitative decisions. Although joint reduction has traditionally been considered the primary determinant of functional outcome, recent perspectives suggest that restoration of foot shape and alignment may be more predictive of long-term functional outcomes. This study investigated the impact of simulated weightbearing (SWB) CT scans on hindfoot alignment and their potential as an economical alternative to true weightbearing (WB) CT imaging.

Methods: In total, 41 patients (male: 85%, mean age: 45 years, SD = 12) with unilateral displaced intraarticular calcaneus fractures (AO/OTA 82C1-3) that were treated surgically were included in this multicenter prospective cohort study. Standard and simulated WB CT scans were obtained at 3 months post-injury for both injured and uninjured calcanei. WB conditions were simulated using a custom dynamic simulator, in which the patient wore a harness connected to a force plate located under the heels. This system allowed for controlled compression by adjusting the side straps while ensuring the patient remained motionless. Key anatomic parameters were measured, including medial (MCVA) and central calcaneal varus angle (CCVA). The difference between WB- and non-WB-injured and uninjured ankles were analyzed using paired t-tests.

Results: Simulated WB conditions significantly altered hindfoot alignment in both injured and uninjured calcanei. For injured calcanei, MCVA changed from 7.5° in the non-WB images to -3.5° with SWB ($p < 0.0001$), while CCVA decreased from 13.1° (non-WB) to 6.5° (WB) ($p = 0.0002$). In uninjured calcanei, MCVA was reduced from 14.5° (non-WB) to 2.5° (WB) ($p < 0.0001$), and CCVA decreased from 19.3° (non-WB) to 11.8° (WB) ($p < 0.0001$). These findings suggest that SWB imaging more accurately represents the functional alignment of the hindfoot compared to standard non-WB CT scans.

Conclusion: Simulated weightbearing CT scans significantly alter the measured alignment of the hindfoot, providing a more functionally relevant assessment of residual deformity after calcaneal fractures. Given their ability to approximate true WB conditions without requiring specialized WB CT scanners, SWB scans present an accessible alternative for clinical and research applications.