

Sagittal Plane Motion of the Ankle and Adjacent Joints in Total Ankle Replacement

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Introduction/Purpose: Patients with ankle arthrodesis exhibit hypermobility of adjacent joints that is hypothesized to result in accelerated arthritis. One theoretical advantage of total ankle replacement (TAR) over arthrodesis is preserved ankle motion and reduced stress on adjacent joints. We hypothesized that sagittal plane radiographic assessment will demonstrate “true” ankle motion of the prosthesis is less than the total arc of hindfoot motion secondary to contributions from adjacent joints. We aimed to compare fixed versus mobile-bearing prostheses for: (1) true ankle motion after TAR, (2) contribution of adjacent joint and midfoot motion that can lead to artificially inflated observed ankle motion (3) progression of subtalar and talonavicular joint arthritis. Previously described radiographic parameters were measured to allow for comparison of TAR motion to published ankle arthrodesis values.

Methods: Patients underwent standardized weightbearing maximum dorsiflexion and plantar flexion sagittal radiographs. Previously described ankle and foot measurements were performed on each dorsiflexion and plantar flexion radiograph to determine the maximum observed ankle motion, true ankle motion through the prosthesis, motion through the subtalar joint, motion through the talonavicular joint, and talo-first metatarsal (midfoot) motion. Pre- and post-operative modified Kellgren-Lawrence grades of subtalar and talonavicular osteoarthritis were assigned to each patient preoperatively and latest follow-up. A minimum of two years of follow-up was needed.

Results: Three prostheses were evaluated and 197 patients met inclusion criteria (75 INBONE, 52 Salto-Talaris, 70 STAR). Mean time to final ROM radiographs was 42.9 months. Mean true ankle motion through the prosthesis (25.9°) was less than the mean hindfoot motion arc (37.4°) that would be observed during clinical assessment. Mean subtalar motion was 8.6° and mean change in Meary's angle was 16.5° . No significant difference was identified between prosthesis or fixed versus mobile-bearing design for the above parameters. The mobile-bearing STAR demonstrated more talonavicular joint motion (7.2°) than both fixed-bearing prostheses (INBONE 5.0° , $p=0.02$; Salto-Talaris 4.8° , $p=0.02$). There was no identifiable progression of modified Kellgren-Lawrence grade of subtalar or talonavicular arthritis when stratified by prosthesis or bearing type and adjusted for time to final follow-up.

Conclusion: This study demonstrated that true ankle motion after TAR is approximately 10 degrees less than the total arc of clinical hindfoot motion—a difference that can be attributed to adjacent joint and midfoot motion. Additionally, no difference in true ankle motion or total arc of hindfoot motion was identified between fixed versus mobile-bearing designs. Counterintuitively, the mobile-bearing STAR prosthesis demonstrated significantly more adjacent joint talonavicular motion than its fixed-bearing counterparts. Progression of subtalar or talonavicular arthritis was not correlated with prosthesis or bearing type in this study and subtalar motion (8.6°) appears similar between TAR and historical arthrodesis controls (9.3°).

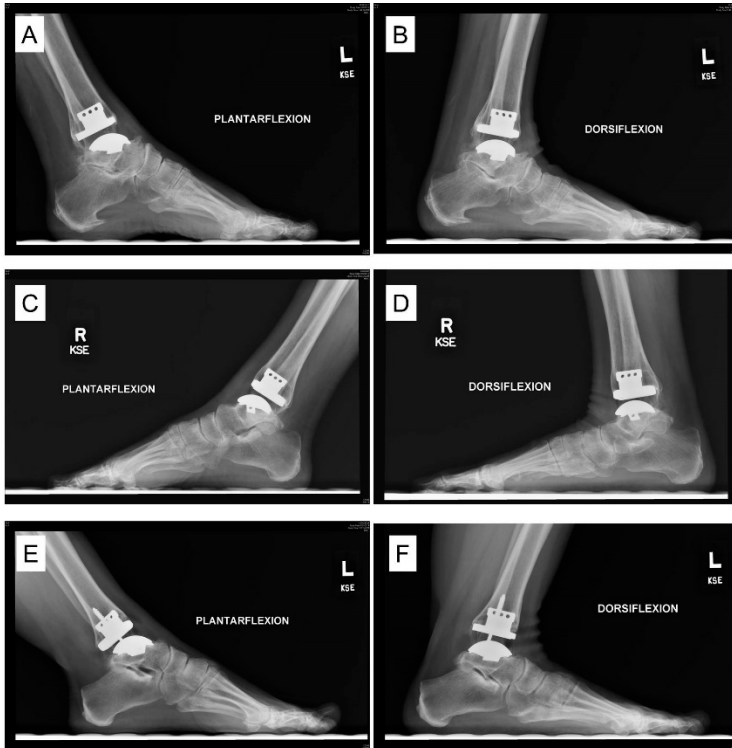


Figure 1. Plantar flexion and dorsiflexion radiographs demonstrating primary additional contribution to ankle motion from the midfoot (A and B), the talonavicular joint (C and D) and the subtalar joint (E and F).