Effect of Subtalar Arthrodesis on Gait Kinematics in the Setting of Total Ankle Arthroplasty: A Study of Cadaveric Gait Simulation

Presenting Author:
Andrew J. Rosenbaum, MD

Additional Authors:
Josh R. Baxter, PhD, Daniel R. Sturmiick, MS, Constantine A. Demetracopoulos, MD, Scott J. Ellis, MD, Jonathan T. Deland, MD

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Introduction/Purpose: Patients undergoing total ankle arthroplasty (TAA) often have symptomatic adjacent joint arthritis and deformity. Adjunctive procedures are frequently indicated in this setting in an attempt to ensure a stable and plantigrade ankle and hindfoot postoperatively. Although subtalar arthrodesis can effectively address a degenerative hindfoot, it may also place abnormal stress on the TAA, leading to premature failure. The objective of this study was to determine the effect of subtalar arthrodesis on TAA and adjacent joint kinematics using cadaveric gait simulation. We hypothesized that differences in ankle and talonavicular joint kinematics would be observed between TAA specimens with and without subtalar arthrodesis.

Methods: Three mid-tibia cadaveric specimens (all female, average age at death: 48) with neutral foot alignment and no history of lower extremity trauma or surgery were tested in a robotic gait simulator. Each tibia was secured to a static mounting fixture about a six-degree of freedom robotic platform (Figure 1A). During simulations, a force plate was moved relative to the stationary specimen through an inverse tibial kinematic path based on standardized in vivo data.

Salto Talaris total ankle prostheses were implanted (Tornier, Inc., Bloomington, MN) by a foot and ankle fellowship trained orthopaedic surgeon. Gait simulation was then performed. Each specimen then underwent in situ subtalar arthrodesis via fluoroscopically guided screw placement and subsequent gait analysis. The kinematics of TAA and TAA with subtalar arthrodesis during simulated walking were then compared using two-tailed, paired Student’s t-tests with an alpha value set at p = 0.05.
**Results:** Analyses revealed that kinematics differed between specimens with TAA and those with TAA and subtalar arthrodesis (Figure 1B). During mid-stance, less ankle plantarflexion was observed in specimens with TAA and subtalar arthrodesis, as compared to those with isolated TAA. This difference was statistically significant (p < 0.05). With regard to axial motion in the ankle, significantly less external rotation was observed in early and mid-stance in specimens with TAA + subtalar arthrodesis (p < 0.05). Talonavicular kinematics also differed between cohorts (Figure 1B). In early and late stance, significantly decreased inversion was observed in specimens with subtalar arthrodesis (p < 0.05). And in early stance, talonavicular joint adduction was significantly diminished in the TAA + subtalar arthrodesis specimens, as compared to those with isolated TAA (p < 0.05).

**Conclusion:** Via cadaveric gait simulation, our study describes the kinematic effects of subtalar arthrodesis on TAA. When TAA is performed in the setting of subtalar arthrodesis, both ankle sagittal and axial plane motion are altered, as are coronal and axial plane motion in the talonavicular joint. Because current clinical literature remains inconclusive on this relationship, additional work must be performed to better delineate the biomechanical and clinical sequelae of TAA performed with subtalar arthrodesis.