Correlating Range of Motion and Temporospatial Parameters with Favorable Outcomes After Total Ankle Arthroplasty

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INTRODUCTION: Degenerative joint disease (DJD) of the ankle is a condition that can limit patient activity and cause pain.[1,6] Recent literature has demonstrated significantly altered temporospatial parameters in patients with DJD of the ankle when compared to healthy controls.[6] Total ankle arthroplasty (TAA) has emerged as a procedure that can alleviate pain while restoring range of motion.[1,] Many studies have shown markedly improved patient-reported outcome scores (PROs) and temporospatial parameters after TAA.[1,2,3] However, there is a paucity of literature correlating PROs after TAA with postoperative range of motion and temporospatial gait data. The objectives of the study were 1) To determine if there are any correlations between postoperative PROs and postoperative range of motion (ROM) and temporospatial gait data and 2) to determine if there are differences in outcomes, ROM, and temporospatial gait metrics between fixed and mobile bearing ankle arthroplasty implants. It was hypothesized that 1) there would be correlations between temporospatial gait data and postoperative PROs and 2) patients with mobile bearing TAA would have greater postoperative PROs than patients with fixed bearing TAA.

METHODS: Participant data from an IRB approved protocol who underwent TAA with mobile bearing implants between 2014 and 2020 were retrospectively analyzed along with control data from a study examining TAA with a fixed bearing implant. Participants were included if they had postoperative range of motion and temporospatial data and completed PROs questionnaires at minimum 6-month follow-up for the American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot score and the 36-Item Short Form Survey (SF-36). Range of motion data were collected postoperatively at most recent follow-up. An infrared 12-camera motion system was used to collect temporospatial gait data while walking along a 30-foot walkway. Statistical significance was defined as $p < 0.05$. Pearson's correlation coefficients were calculated for the AOFAS and SF-36 between ROM and temporospatial data. Additionally, Welch's two sample t-tests were used to compare data between mobile bearing and fixed bearing total ankle implants.

RESULTS: Six participants who underwent mobile bearing TAA and historical data from seven participants who underwent fixed bearing TAA were included in the study. The average postoperative AOFAS score for the mobile and fixed bearing groups were 84 and 81, respectively ($p = 0.71$). Additionally, average cadence between the mobile and fixed bearing implants was 98 steps/min and 111 steps/min, respectively ($p = 0.05$). There were no statistically significant differences when analyzing postoperative PROs, ROM, and temporospatial parameters between fixed and mobile bearing implants. Pearson's correlation coefficient did not find any statistically significant correlations between postoperative PROs and ROM and temporospatial parameters in mobile bearing implants. However, stride length was associated with overall postoperative SF-36 score 95% confidence interval (CI) [0.16, 0.97] ($p = 0.03$), as well as the physical function 95% CI [0.78, 1.00] ($p < 0.001$) and pain 95% CI [0.40, 0.98] ($p = 0.01$) SF-36 subsections in the fixed bearing group.

DISCUSSION: Patients undergoing TAA with mobile bearing and fixed bearing had similar postoperative PROs, ROM, and temporospatial parameters. Additionally, stride length was correlated with postoperative PROs in the fixed bearing implant group, which is a key parameter of gait efficiency and function. Previous studies have showed patients with DJD in the ankle have significantly worse stride length than health patients.[6] Moreover, recent papers have demonstrated patients undergoing TAA experiencing significant improvements in stride length and PROs.[5] The current study highlights this potential relationship between stride length and postoperative PROs and may help identify objective measurements associated with favorable outcomes after TAA. The study partially confirms the initial hypothesis that postoperative PROs were correlated with temporospatial gait data. However, the mobile bearing TAA group did not have any correlations between postoperative PROs and ROM or temporospatial gait data. Moreover, the study differs from the initial hypothesis of mobile bearing TAA having superior outcomes and showed no difference in postoperative PROs between mobile bearing and fixed bearing TAA implants. It is important to note the small sample size of the study. Further studies that are adequately powered should be conducted to confirm these initial findings. Previous studies have established that 20 patient sample size would achieve 80% power when if postoperative AOFAS scores under 35 would be indicative of foot or ankle disorders and scores over 80 would represent healthy patients.[4] Studies with longer follow-up should be conducted to determine whether the initial findings remain in long-term follow-up.

CLINICAL RELEVANCE: This study found that temporospatial gait data is correlated with postoperative PROs in fixed bearing TAA implants. It was also found that there is no difference in postoperative PROs between mobile bearing and fixed bearing TAA implants.

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Table 1. Significant Correlations Between Fixed Bearing Implant Temporospatial Parameters and Postoperative SF-36 Scores

Postoperative PRO	Temporospatial Parameter	r	95% Confidence Interval	P Value
SF-36	Stride Length	0.81	[0.16, 0.97]	0.026
SF-36 Physical Function	Stride Length	0.97	[0.78, 1.00]	<0.001
SF-36 Pain	Stride Length	0.89	[0.40, 0.98]	0.008