

## **Measures of Gait Before and After Ankle Arthroplasty**

Michael Civitello\*, Laura Tomayko\*, Stephen Aitken\*,  
Stephen F. Conti<sup>†</sup>, Mark Carl Miller\*<sup>†</sup>

\*Duquesne University, Pittsburgh PA

<sup>†</sup>University of Pittsburgh, Pittsburgh, PA

**Introduction:** Joint replacement is performed routinely on patients with arthritic degeneration and loss of function of the knees and hips. Ankle replacement, however, is far less common and has only recently become clinically viable. The purpose of this study was to compare the pre-operative gait of patients scheduled to undergo total ankle arthroplasty to those of patients who have previously had this procedure. The results will quantify functional improvement due to ankle replacement, which has seen limited study [2,3].

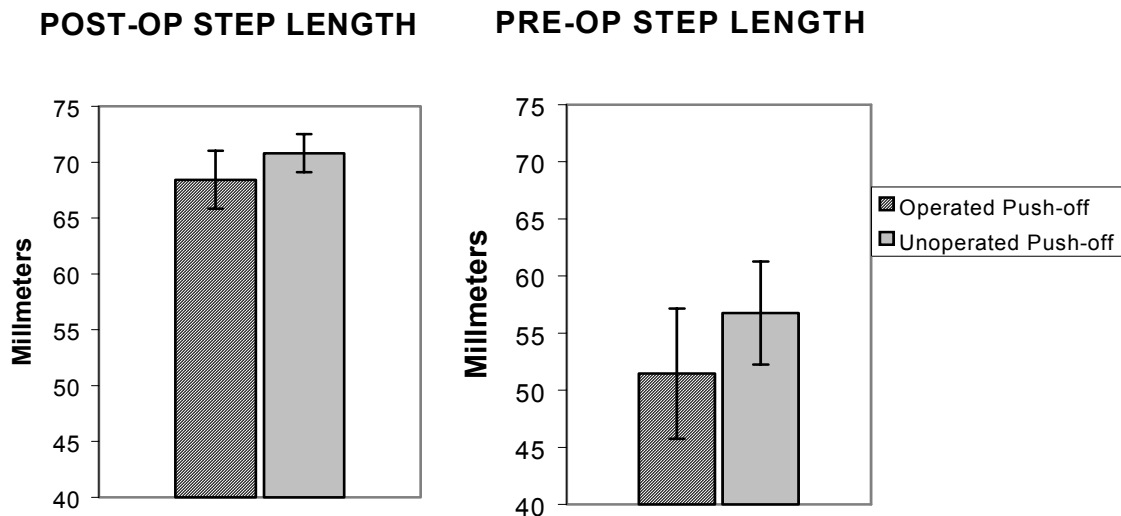
**Statement of Clinical Significance:** Currently, arthrodesis is the standard treatment procedure for patients with arthritic ankle degeneration. While pain relief is an expected outcome of arthrodesis, restoration of normal function is not. This can be attributed primarily to a loss of ankle motion. Patients commonly compensate for the loss of ankle joint motion and thereby place greater stresses on the lower kinetic chain, primarily at the subtalar and midtarsal joints. This increased stress can result in degeneration of these joints over time, causing further loss of function. Ankle arthroplasty should be considered a desirable treatment option for arthritic degeneration of the ankle if it can relieve pain as well as restore normal gait patterns, preventing compensatory movements and the stresses that result.

**Methodology:** A total of 51 patients, 29 pre-operatively and 22 post-operatively, were included in the study. The post-operative group had undergone unilateral ankle arthroplasty performed by the clinical co-investigator (SFC), using a non-cemented prosthesis (Agility Ankle, DePuy, Inc). The pre-operative group was comprised of patients scheduled to undergo the same procedure and was tested in a period ranging from 1-7 days before surgery. The patients in the post-operative group were tested once in a period of 11-19 months after surgery. All of the patients were tested in the gait analysis laboratory at Duquesne University. Patients' lower extremity bony landmarks were indicated with reflective markers, as follows: greater trochanter, lateral femoral epicondyle, fibular head, lateral malleolus, lateral calcaneus, and fifth metatarsal. Patients were then asked to walk at a normal pace back and forth across a 25-foot runway. A force plate (Bertec) measured all foot-floor forces. Subjects walked until there were three distinct foot strikes on the force plate with each foot. Gait pattern data was gathered using a video-based motion analysis system (Peak-5, Peak Performance, Inc.)

**Results:** Using a paired t-test ( $p < 0.05$ ), a statistically significant difference in step length was found between the two groups. The step length increased from 51.5 mm (5.7) to 68.4 mm (2.6) on the operated side and from 56.8 mm (4.5) to 70.8 mm (2.9) on the unoperated side. There was also a statistically significant deficit in the vertical foot-floor force at the second weight-bearing peak (push-off phase) for the post-operative group when comparing the unoperated to the operated side ( $p < 0.05$ ). Normalized by body weight, the pre-operative

vertical force was 1.02 and post-operative force was 1.10. Only one patient in the post-operative group reported any pain during normal walking. Eight reported stiffness and mild pain at the end of the day.

**Discussion:** The goal of surgical and therapeutic interventions should be the restoration of function and relief of pain. The results of this study indicate that ankle arthroplasty is an effective treatment for the relief of pain as well as restoration of function. Gait patterns of patients following ankle arthroplasty were significantly improved when compared to pre-operative gait patterns, as evidenced by the increased step length for both the affected and non-affected side. The post-operative weight-bearing deficit is similar to one occurring in arthrodesis patients as reported by Wu et al [1]. The significance of this similarity is unknown at this time, but warrants further investigation.



**References :**

- 1) Wu W-L, Su F-C, Cheng Y-M, Huang P-J, Chou Y-L, Chou C-K. Gait analysis after ankle arthrodesis. *Gait and Posture* II (2000) 54-61.
- 2) Demottaz J. D., Mazur J. M., Thomas W. H., Sledge C. B., Simon S. R. Clinical study of total ankle replacement with gait analysis, a preliminary report. *The Journal of Bone and Joint Surgery* Vol. 61-A, No. 7. October 1979 p. 976 – 988
- 3) Stauffer R. N., Chao E. Y. S., Brewster R. C. Force and motion analysis of the normal, diseased and prosthetic ankle joint. *Clinical Orthopaedics and Related Research* No. 127 September 1977 p.189 – 196.

**Acknowledgement:** The partial support of DePuy Inc is greatly appreciated.