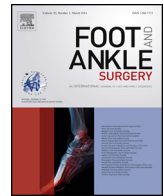




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Functional and clinical outcomes of total ankle arthroplasty in elderly compared to younger patients☆☆☆

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ABSTRACT

Background: Total ankle arthroplasty (TAA) is becoming an increasingly utilized procedure for the management of end-stage ankle arthritis. Elderly patients are the fastest growing segment of the population in the western world, creating a unique challenge to the health economics of our era. Determining if elderly patients with end-stage ankle arthritis demonstrate the same improvements in clinical outcomes and functional measures of gait following TAA would be valuable. This can aid to evaluate the utilization of TAA in this enlarging cohort of our population.

Methods: Consecutive series of twenty-one patients over the age of 70, who underwent TAA for end-stage ankle arthritis, was prospectively compared to a series of twenty-one patients aged 50–60, who underwent the same procedure by single surgeon during same time period.

Clinical outcomes were measured with outcome scores including VAS pain score, AOFAS Ankle and Hindfoot Score, and the SF-36. Three-dimensional gait analysis was performed preoperatively and at a minimum of one year postoperatively, to measure temporal-spatial, kinematic, and kinetic parameters of gait. Mixed model multivariate statistical analysis was used to evaluate and compare the independent contributions to outcomes of the surgical intervention over time; of patient age; and of time-plus-age interaction, as these influenced both the clinical outcomes and the functional gait outcomes.

Results: Statistically significant improvements in VAS pain scores, AOFAS ankle/hindfoot scores, and SF-36 scores were demonstrated in both age groups. Following surgery, there were improvements in all parameters of gait, including temporal-spatial parameters as step length and walking velocity; kinematic parameters, including, increase in total range of motion to a total of 17–19°; and kinetic parameters, including increase in ankle power and moment. The improvements both in clinical and gait outcomes were equivalent in the two age groups.

Conclusions: In this comparative study, it is shown that both elderly patients over the age of 70 and younger patients aged 50–60 demonstrated equivalent improvements clinical and gait outcomes following ankle arthroplasty. This may be important data both for clinical decision-making and the health economics for our ageing population.

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1. Introduction

Total ankle arthroplasty is gaining popularity as treatment for end-stage ankle arthritis. Multiple authors, using a range of

different prostheses, have reported encouraging clinical results following total ankle arthroplasty with improved function and significant pain reduction [1–16].

In addition to positive clinical outcomes, multiple studies have documented functional improvement, as measured by improvements in gait following total ankle arthroplasty. Recent gait studies have shown that ankle arthroplasty significantly produces improved gait compared with preoperative gait, even though does not restore gait to the level normal controls [5,12,13,17–24].

☆ An investigation of the Human Motion and Performance Laboratory of Baylor University Medical Center, Dallas, Texas.

☆☆ Level of evidence: Level 3, retrospective cohort.

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Ankle arthroplasty has been shown to produce increased joint movement, improved symmetry of gait, and restoration of a more normal pattern of ground reaction force [17,22,23,25–28].

Elderly patients are the fastest growing segment of the population in the western world, creating a unique challenge to the health economics of our era [29]. Determining if elderly patients with end-stage ankle arthritis demonstrate the same improvements in clinical outcomes and in functional measures of gait following TAA would be valuable to determine the appropriate utilization of this procedure in this enlarging cohort of our population.

Strasser and Turner [30] retrospectively studied ankle arthrodesis outcomes in elderly patients over the age of 70. Authors showed, functional outcomes measured with FAAM and AOFAS scores to be satisfactory, and union rate to be comparable with previous reports for younger patients. Authors concluded that ankle arthrodesis is an effective surgical treatment option in an elderly patient population.

However, it is yet undetermined whether elderly patients with end-stage ankle arthritis experience the same clinical and functional improvements produced by ankle arthroplasty as younger patients.

Only a handful of studies addressed the performance of patients undergoing total ankle arthroplasty according to patients' age.

These studies focused mainly, on complications, implant survival and revision rates [31–33]. Fevang et al. [33] showed age did not influence revision rates. Conversely, Henricson et al. [32] showed that a lower age at time of index surgery implied increased risk for revision. Spirt et al. [31] reported that patients under the age of 54 who underwent TAA had a 1.45-times greater risk of reoperation and a 2.65-times greater risk of implant failure than older patients.

A recent study [34] examined the effect of age on total ankle arthroplasty on patient-reported outcomes. Authors showed that younger patients had similar clinical outcomes as older patients in early followup. However, no functional measurements such as gait analysis were utilized.

Kofoed and Lundberg-Jensen [9] retrospectively, reported on 100 patients treated with total ankle arthroplasty for osteoarthritis or rheumatoid arthritis of the ankle joint, followed for up to 15 years. The authors reported no difference in implant survivorship between patients older or younger than 50 years. Gain in total clinical scores was similar between the groups except a difference in the mobility component score, which was lower in the younger than 50 years patient group. However, the authors used the non-validated Kofoed ankle score.

Hintermann et al. [7] presented a review on the use of total ankle arthroplasty in elderly patients for the treatment of end-stage arthritis. Authors evaluated the potential advantages of total ankle arthroplasty in patients older than 60 years, comparing to tibiotalar arthrodesis. The authors concluded that TAA should be considered the treatment of choice in elderly patients, especially those with low activity level, as it requires less postoperative immobilization, and allows earlier weightbearing. However the data and methodology leading to this Level 5 conclusion were not presented.

The purpose of this study was to compare and functional outcomes, as measured by three-dimensional gait analysis, and patient-reported clinical outcomes, following total ankle arthroplasty between younger patients (50–60 years old) and elderly patients (over 70 years old), in order to determine the effectiveness of this procedure in elderly patients.

2. Methods

A prospective gait study of patients with end-stage ankle arthritis, who were treated with the Scandinavian Total

Ankle Replacement (STAR™) total ankle arthroplasty, was conducted. Twenty-one consecutive patients over the age of 70 were identified, and compared with a consecutive group of twenty-one younger patients, aged 50–60 years. All arthroplasties were done by the same senior author (JWB) between the years 1999 to 2011, at the same institution, and by the same surgical team.

This study was approved by the Institutional Review Board. Each patient enrolled in the study gave informed consent.

Clinical outcome scores collected preoperatively and postoperatively, included the Visual Analog Scale (VAS) pain score, the American Orthopaedic Foot and Ankle Society (AOFAS) Ankle and Hindfoot Score, and the Short Form 36 (SF-36) scores. Minimum followup was 2 years.

Subjects underwent a three-dimensional gait analysis before and after total ankle arthroplasty. Minimum follow up for the postoperative gait study was 2 years. Individual subject data was taken from the most recent annual gait analysis. The mean interval between surgery to the latest clinical follow up and gait analysis was 2.3 years for the elderly patients group, and 2.2 years for the group of younger patients.

2.1. Gait analysis

Preoperative gait analysis was performed within the 2 weeks prior to the surgery. Kinematic data were collected at 100 Hz with use of a twelve-camera digital Vicon motion capture system (Vicon, Los Angeles, California). Kinetic parameters were collected with two AMTI OR6-5 force plates (Advanced Medical Technology, Watertown, Massachusetts) and recorded at 1000 Hz. Markers position and gait analysis technique were done as previously described using a single segment foot model.

Retro-reflective markers were placed bilaterally on the anterior superior iliac spine, the posterior superior iliac spine, laterally on the femur, the lateral epicondyle of the knee, laterally on the tibia, the lateral malleolus, and the head of the second metatarsal and on the posterior aspect of the calcaneus, positioned at the same height as the marker on the second metatarsal head. Markers were also placed bilaterally on the medial epicondyle of the knee and medial malleolus during a standing static trial in order to calculate knee and ankle joint centers, respectively. Patients walked barefoot at a self-selected speed over a 10-m walkway. A minimum of 20 gait cycles were used for averaging and statistical analysis for temporal-spatial and kinematics parameters and a minimum of 5 force plate readings were used for kinetic parameters.

Gait parameters were collected for both the affected (i.e. operated) limb and the unaffected limb.

Temporal-spatial measurements were cadence, step length, walking velocity and single, double and total support times. Kinematic parameters were sagittal plane total range of motion, mean peak plantarflexion and mean peak dorsiflexion for the ankle. Sagittal plane angle at initial contact (IC), minimal and maximal range of motion were measured. Knee and hip total range of motion were recorded as well. Kinetic parameters measured were sagittal plane ankle power and ankle moment.

2.2. Statistical analysis

Baseline preoperative measurements were compared between the two age groups using independent sample student t-test for continuous variables. Mixed model was used to evaluate the time, age and time age category interaction effects on gait parameters. Statistical analysis was performed, using JMP 10, by a biostatistician. Statistical significance was set at $p < 0.05$.

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