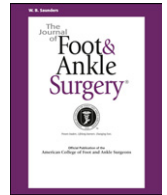




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Analysis of Ankle Range of Motion and Functional Outcome Following Total Ankle Arthroplasty

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ABSTRACT

The success of ankle joint replacement has primarily been reviewed with respect to patient morbidity and survivorship rather than patient satisfaction. A retrospective review was performed of 95 patients who had undergone a total ankle replacement and who had completed both postoperative range of motion fluoroscopy and a subjective patient score sheet. Collected data included age, body mass index, length of follow-up, presence of complications, performance of adjunctive procedures, range of motion, and the etiology of the end-stage arthritis. These variables were then compared with patient satisfaction to see if there were any predictive conditions of successful outcomes. Patients older than 60 years and those with a body mass index (BMI) less than 30 demonstrated a significant positive association with subjective satisfaction scores ($P = .0023$ and $.0008$, respectively). The amount of postoperative range of motion did not appear to correlate with patient satisfaction. Furthermore, there were no significant associations of patient satisfaction with a patient age younger than 60 years, a BMI greater than 30, additional procedures, perioperative complications, the length of time after surgery, and the presenting etiology.

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End-stage degenerative joint disease of the ankle secondary to trauma, metabolic joint disease, or some other identified or idiopathic etiology typically results in debilitating loss of mobility, and traditional operative treatment has consisted primarily of tibiotalar arthrodesis (1). The popularity of joint replacement has been attributable, in part, to studies that have demonstrated high rates of adjacent joint arthrosis and poor functional outcomes with fusion (2, 3). The obligate loss of motion changes the compensation mechanisms of the distal portion of the lower extremity and has a significant impact on locomotion (4–6). Furthermore, total ankle arthroplasty has improved with the advent of more anatomically sound designs, and a better appreciation of the importance of soft tissue stability and proper alignment of the foot (7–9).

The assessment of joint replacement has traditionally been by subjective score systems, patient morbidity, and by the total arc of motion following replacement (10–14). A recent 9-year follow-up study of 126 patients demonstrated an 11% revision rate and an overall improvement in ankle pain in 94% of the cohort, with an average of 18° of total ankle range of motion; and even though the

amount of ankle dorsiflexion did not exceed neutral, 92% of the patients studied were satisfied with the outcome of the surgery, and pain relief was the major determinant of patient satisfaction (15). Several other significant associations were also reported in regard to predictors of overall success. In particular, those patients with a preoperative diagnosis of posttraumatic arthritis were less satisfied with the overall relief of pain, and age, weight, and a plantarflexion contracture were not accurate predictors of pain relief (15).

Recent results of total ankle arthroplasty have illustrated promising clinical and subjective outcomes, even though the observed excursion of postoperative ankle motion has been less than what was anticipated, and a substantial proportion of patients related that their overall motion was not as great as they had anticipated it would be (11, 13–17). Empirical observation of patients in the early postoperative period has, in fact, led us to question the association of overall ankle range of motion with patient satisfaction, independent of pain relief. The purpose of this study was to ascertain if there was an association between postoperative ankle range of motion and patient satisfaction. Furthermore, we aimed to determine the influence of patient age, body mass index (BMI), arthritis etiology, and postoperative duration on patient satisfaction.

Patients and Methods

A review of 124 patients who underwent total ankle arthroplasty using the Agility LP Total Ankle Replacement (DePuy Orthopaedics, Inc., Warsaw, IN) was performed by

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a single surgeon (J.M.S.) over the 6-year period from May 2000 to May 2006. Medical records, serial radiographs, and postoperative clinical fluoroscopic scans were reviewed by the surgeon (J.M.S.). Medical charts were reviewed to determine past medical history, the etiology of the end-stage ankle joint degenerative disease, age, gender, BMI, the occurrence of a postoperative complication, and length of follow-up. Postoperative complications were defined as subsidence, fibular impingement, wound dehiscence, infection, syndesmosis nonunion, delayed union, nerve impingement, implant loosening, malposition (owing to uncontrolled ankle instability), and hardware irritation (18). Fluoroscopy was used to measure postoperative ankle joint range of motion at 3, 6, and 12 months and then annually. The landmarks used to determine the total range of ankle motion were those previously described by Coetzee and Castro (11); however, for the purposes of our investigation, this motion was determined with the patient lying on the ipsilateral hip with the knee flexed to relieve the influence of the gastrocnemius. The lateral side of the foot was placed on the fluoroscopic unit and the same examiner (J.M.S.) performed all range of motion maneuvers. The foot was positioned so that the keel of the tibial and talar components of the implant was orthogonal to the central ray, and the involved ankle was taken through a range of motion in both directions without detectible muscle activity by the patient. The end points of ankle dorsiflexion and plantarflexion were documented with a printed copy of the image, and the excursion in each direction was determined by measuring the angle subtended by a line tangential to both the tibial and talar components (Figure 1). The total range of ankle motion was determined by adding the dorsiflexion and plantarflexion values, and recorded in degrees.

Patient satisfaction was measured with the American College of Foot and Ankle Surgeons (ACFAS) subjective module 4, ankle score sheet (19) (Figure 2). The instrument was administered to the first 124 consecutive patients who had undergone total ankle replacement and who were at least 1 year postoperative. As such, patients had the survey administered at various intervals after the index operation, but no sooner than 1 year postoperative. Patient age, range of ankle motion, gender, BMI, length of follow-up, arthritis etiology, presence of adjunctive procedures, and perioperative complications were analyzed relative to the patient satisfaction score. Patients were subdivided into 3 groups according to their age at the time of the index procedure, including those younger than 50 years, those 50 to 59, and those 60 years or older. The etiology of ankle arthritis was subdivided into 2 groups, the first being those with a history of trauma (posttraumatic), and the second being those with rheumatoid arthritis, pigmented villonodular synovitis, residual clubfoot, or an idiopathic cause. After abstracting the data and measuring outcomes, statistical analyses were performed using chi square or paired *t* tests, and statistical significance was defined at the 5% ($P \leq .05$) level.

Results

Of the 124 total ankle replacement cases, we were able to compile complete data sets, including the subjective outcome survey, for 95 cases in 94 patients, one of the patients having undergone bilateral total ankle replacement (TAR). There were 52 females and 42 males, and the length of follow-up varied from 1 to 5 years. Thirty-five patients (35 ankles) had range of motion studies recorded at a time more than 1 year postoperative. Because data collection was ongoing, only those patients who had undergone TAR early in the observation period had their ankle range of motion determined at 2 years or more postoperative. The mean age of the patients at the time of implantation was 59 (range 23 to 74) years and the mean BMI was 27.9 (range 20.3 to 34.9), with 68% of the patients having a BMI higher than 30. In regard to etiology of ankle arthritis, 40 (42.10%) of the ankles were posttraumatic; 13 (13.68%) were degenerative secondary to rheumatoid arthritis or pigmented villonodular synovitis; 31 (32.63%) were acquired secondary to chronic ankle instability, ankle valgus associated with pes planus, or as a manifestation of clubfoot deformity; and 11 (11.58%) were idiopathic. In regard to adjunct procedures, 44 (46.32%) of the ankles were replaced in conjunction with additional procedures, including arthrodesis of the subtalar, talonavicular, or first tarsometatarsal joint, and/or calcaneal osteotomy, gastrocnemius recession, and first metatarsal osteotomy.

Perioperative complications included subsidence of the talar component in 3 (3.16%) ankles, aseptic minor wound healing problems in 8 (8.42%) ankles, infection that required parenteral antibiotic therapy in 2 (2.1%) ankles, nonunion of the syndesmosis in 5 (5.26%) ankles, osteolysis at the fibular interface with the tibial component in 12 (12.63%) ankles, and frontal plane instability of the talar component in 7 (7.37%) ankles. However, all of these complications occurred

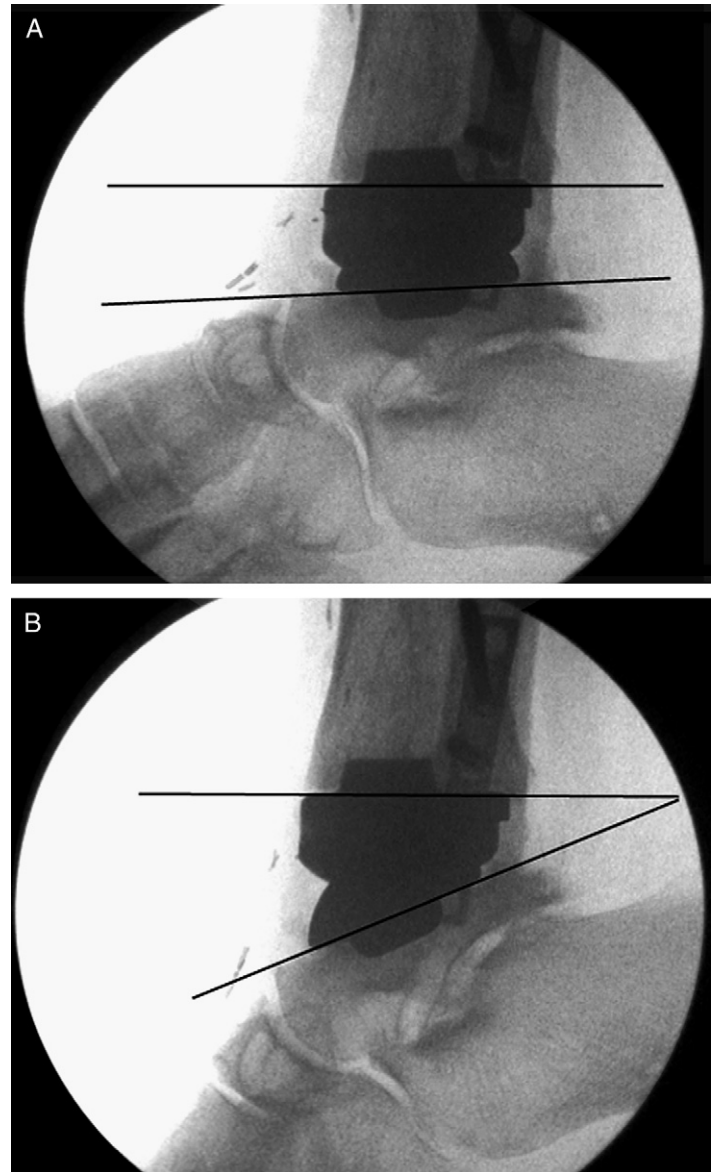


Fig. 1. (A) Fluoroscopic image showing maximal dorsiflexion. The angle subtended by the 2 lines quantifies the degree of dorsiflexion. (B) Measurement of maximal plantar flexion in the same patient.

in 16 patients (16.8% of all ankles). One of the patients who developed infection underwent surgical exchange of the polyethylene liner, and the other case of infection did not extend into the joint.

The association between ankle range of motion and subjective patient satisfaction was determined at the point in time of the latest data collection for each patient. Fifty-eight ankles (61.05%) displayed a total range of ankle excursion of greater than 20° at the time of administration of the ACFAS satisfaction score instrument. Of those 58 ankles, 38 (65.52%) had patient satisfaction scores higher than 35 (70% of total possible score), and this was not statistically significant ($P = .29$). Thirty-one (32.63%) of the ankles displayed a total range of excursion greater than 10° but less than or equal to 20° at the time of administration of the satisfaction score instrument. Of those 31 ankles, 15 (48.39%) had patient satisfaction scores higher than 35, and this was not statistically significant ($P = .22$). Six (6.32%) of the ankles displayed a total range of excursion of 10° or less at the time of administration of the satisfaction instrument. Of those 6 ankles, 4 of

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