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Relationship Between Body Mass Index and Complications in Total Ankle Arthroplasty: A Single Surgeon's Experience in Ninety-Seven Replacements

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ABSTRACT

The purpose of this study was to compare complication rates of total ankle replacement in 2 groups of patients based on their body mass index (BMI). The total cohort was divided into 2 groups based on BMI. Group 1 included patients with a BMI ≤30 kg/m^2. Group 2 included patients with a BMI >30 kg/m^2. Available charts were reviewed for patients who underwent primary total ankle arthroplasty. Patient demographics, BMI, prosthesis used, concomitant procedures, and intraoperative and postoperative complications were recorded. Ninety-seven patients met the inclusion criteria and underwent total ankle replacement between March 2012 and July 2016. Mean follow-up was 26.3 (range 12 to 62) months. Mean age was 66.4 (range 23 to 85) years. Mean BMI was 29.6 (range 20.6 to 49.5) kg/m^2. Forty-three males and 54 females were included. There were 53 patients in group 1 (BMI ≤30 kg/m^2) and 44 patients in group 2 (BMI >30 kg/m^2). Total complication rates for group 1 and 2 were 18.9% (10 of 53) and 11.4% (5 of 44), respectively. There were a total of 10 minor complications and 5 major complications. There was no statistical difference between the groups (p = .308) in terms of complication rates. All patients underwent at least 1 concomitant procedure at the time of the index ankle replacement. We found that total ankle replacement can be safely utilized in patients with a BMI >30 kg/m^2. In the present study, there was no statistical significance in complication rates in the 2 groups.

End-stage ankle arthritis can be a debilitating condition, often leading to decreased quality of life (1). With advances in implant technology, total ankle replacement (TAR) is becoming frequently used for end-stage ankle arthritis. Additionally, obesity continues to become more prevalent in the United States, with a staggering 36.5% of the total population being obese (2). Early studies recommended TAR for the lightweight patient with low physical demand. Others have concluded that TAR can be an acceptable remedy for end-stage arthritis in the obese population (3). Today's joint surgeons are replacing ankles in patients with much larger body habitus. TAR in the obese population has recently been reported in the literature (3–5). There are mixed results when safety and outcomes are assessed. It is extremely important for surgeons to understand the risk factors that may lead to complications and to make educated recommendations to patients in terms of the best treatment available. Obesity has been reported to have a negative effect on survivorship, functional outcomes, and complications in the elbow, knee, hip, and shoulder literature (6,7). The purpose of this study is to compare the complication rates of TAR in 2 groups based on patient body mass index (BMI). The authors hypothesize that patients undergoing TAR with a higher BMI will have a higher rate of complications and lower patient satisfaction.

Patients and Methods

A retrospective chart review was performed for all patients ≥18 years of age who underwent primary TAR by the senior author (J.M.C.) between March 2012 and July 2016. Indications for total ankle arthroplasty include end-stage ankle arthritis with or without deformity. Patients were excluded from the study if they were unable to follow up with the senior surgeon on a routine basis after the index procedure, had undergone prior total ankle arthroplasty, or had previous ankle arthrodesis, avascular necrosis of the talus, septic arthritis, periarticular osteomyelitis, or a BMI >50 kg/m^2. The total cohort was divided into 2 groups based on preoperative BMI. Group 1 included patients with a BMI ≤30 kg/m^2 (Fig. 1). Group 2 included patients with a BMI >30 kg/m^2 (Fig. 2 *A* and *B*). Available charts were reviewed for patients who underwent primary total ankle arthroplasty during this 4-year period. Patient age, sex, BMI, prosthesis used, concomitant procedures, and postoperative complications were recorded. A minimum follow-up time of 12 months was required. All joint replacement procedures were performed by the senior author (J.M.C).

Statistical Analysis

Categorical variables were compared using either chi-square test or Fisher's exact test. Continuous data were summarized using the mean

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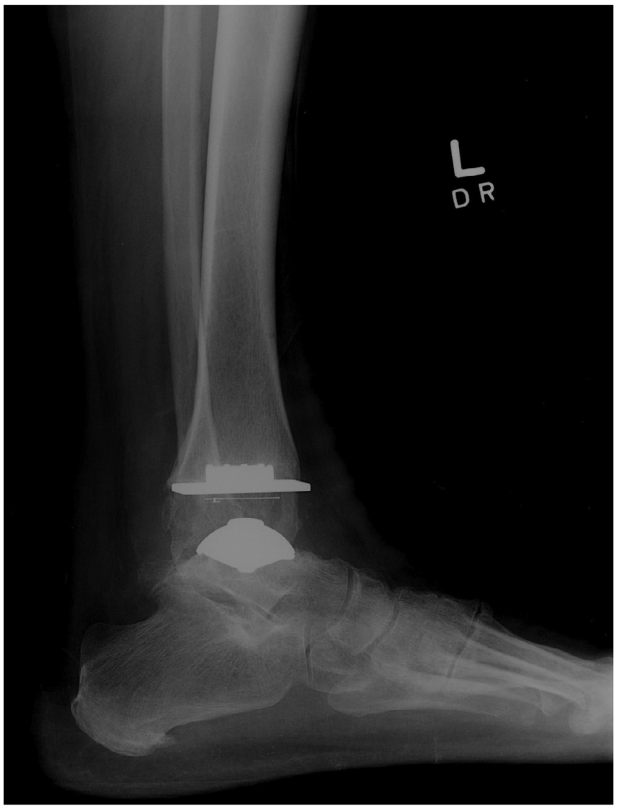

Fig. 1. Postoperative lateral radiograph in a patient with a body mass index <30.

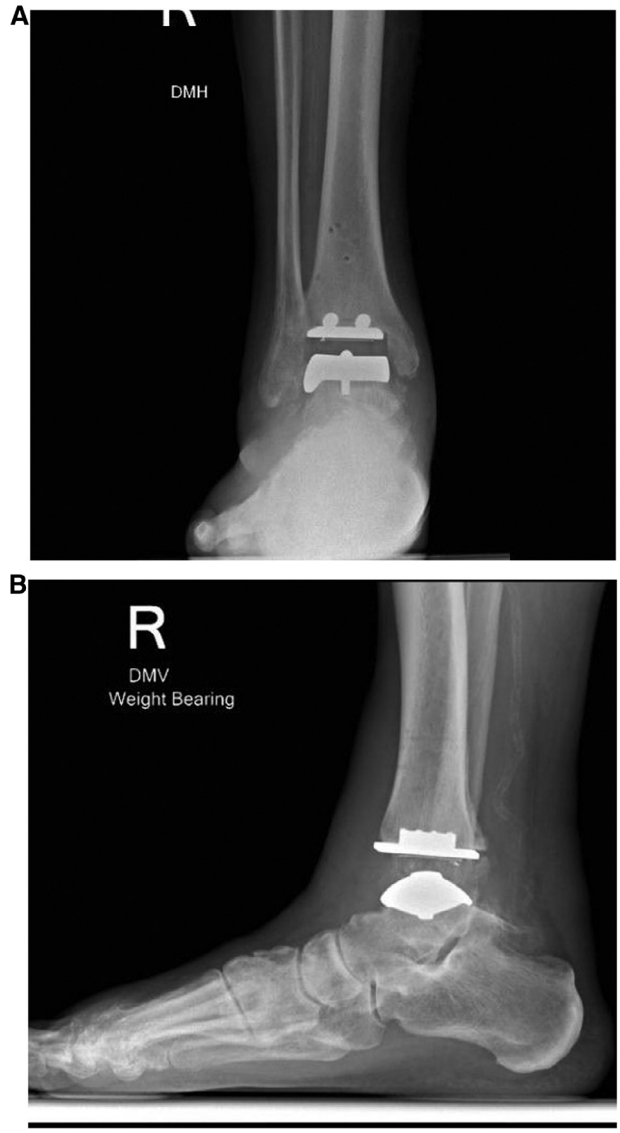

Fig. 2. (*A*) Postoperative anteroposterior radiograph in a patient with a body mass index >30. (*B*) Postoperative lateral radiograph in a patient with a body mass index >30.

and range as appropriate for continuous variables and counts and percentages for categorical variables.

Results

From March 2012 to July 2016, 108 patients underwent TAR. Ninety-seven patients who met the follow-up criteria were included in this study. The mean follow-up time was 26.3 (range 12 to 62) months. Mean age at time of implant was 66.4 (range 23 to 85) years. Mean BMI for the total cohort was 29.6 (range 20.6 to 49.5) kg/m^2. There were 43 males and 54 females included in the study (Table 1). Group 1 (BMI ≤30 kg/m^2) included 53 patients, and there were 44 patients in group 2 (BMI >30 kg/m^2). The mean BMIs for groups 1 and 2 were 26.44 and 34.14 kg/m^2, respectively. The Scandinavian Total Ankle Replacement prosthesis (Stryker, Kalamazoo, MI) was used in 79 patients, Salto/Salto XT total ankle replacement system (Integra Life Sciences, Plainsboro, NJ) in 12 patients, Cadence total ankle prosthesis (Integra Life Sciences, Plainsboro, NJ) in 1 patient, and Infinity total ankle replacement system (Wright Medical Technology, Memphis, TN) in 6 patients. All patients underwent at least 1 concomitant procedure at the time of the index ankle replacement (Table 2). The most common concomitant procedure was tendo-Achilles lengthening. Other procedures included bone marrow aspiration, hardware removal, subtalar arthrodesis, medial displacement calcaneal osteotomy, deltoid release, syndesmotic fusion, and Brostrom lateral ankle stabilization. Complications encountered during the postoperative course included wound healing complications, deep infections, peri-prosthetic fracture, and gutter impingement (Table 3). Complication rates for the total cohort were found to be 15.5% (15 of 97). There were 10 minor complications and 5 major complications. Minor complications included superficial wound breakdowns that all resolved with local wound care and oral antibiotics. When minor complications were excluded from the total cohort, there was a 5.2% (5 of 97) total complication rate. Total complication rates for groups 1 and 2 were 18.9% (10 of 53) and 11.4% (5 of 44), respectively (Table 4). Four of the 5 major complications occurred in the group with a BMI <30 kg/m^2. There was no statistical difference between the groups in terms of total complication rates ($p = .308$). Furthermore, when minor and major complications were compared, there was no statistical difference found between the 2 sets of patients.

Discussion

A recent study by Gross et al (8) reviewed 455 primary TARs. The authors evaluated the effect of obesity on patient outcomes and complication rates. There was no significant difference in complications between the obese and nonobese groups. Bouchard et al (3) reviewed 39 obese patients (BMI ≥30 kg/m^2) and 48 nonobese patients (BMI <30 kg/m^2) who underwent primary TAR. At a mean follow-up time of 3.92 years, there was no statistical difference between the 2 groups in

Table 1
Demographic data for the cohort (N = 97)

Characteristic	Value
Mean age, y (range)	69.4 (47 to 84)
Mean BMI, kg/m^2 (range)	29.6 (20.6 to 49.5)
Mean follow-up time, mo (range)	26.3 (12 to 62)
Sex, n (%)	
Male	43 (45)
Female	54 (55)
Tobacco use, n (%)	
Yes	4 (4.1)
No	69 (71.1)
Quit	24 (24.7)
Diabetes mellitus, n (%)	12 (12.3)
Rheumatoid arthritis, n (%)	6 (6.2)
Concomitant procedures, n (%)	97 (100)

Abbreviation: BMI, body mass index.

Table 2
Concomitant procedures performed (N = 97)

Concomitant Procedure	Group 1 (BMI ≤30 kg/m^2), n = 53	Group 2 (BMI >30 kg/m^2), n = 44
Tendo-Achilles lengthening	53 (100)	44 (100)
Brostrom	15 (28.3)	18 (40.9)
Medial displacement calcaneal osteotomy	1 (1.9)	1 (2.3)
Subtalar arthrodesis	0	4 (9.1)
Hardware removal	4 (7.6)	9 (20.4)
Deltoid release	0	1 (2.3)
Syndesmotic fusion	1 (1.9)	0
ORIF medial malleolus	1 (1.9)	0
ORIF fibula	1 (1.9)	0

Abbreviations: BMI, body mass index; ORIF, open reduction internal fixation.

Table 3
Complications encountered in the postoperative period (N = 97)

Complication	n
Wound complication	10 (10.3)
Deep infection	1 (1.03)
Gutter impingement	2 (2.06)
Peri-prosthetic fracture	2 (2.06)
Total	15 (15.5)

Table 4
Statistical analysis of dichotomized data

	n	Complication Rate, n (%)	*p* Value
Group 1 (BMI ≤30 kg/m^2)	53	10/53 (18.9)	.308
Group 2 (BMI >30 kg/m^2)	44	5/44 (11.4)	
Total	97	15/97 (15.5)	

Abbreviation: BMI, body mass index.

terms of complications or revisions. There was a similar statistical difference found between the pre- and postoperative outcome scores in the groups. The authors concluded that TAR was safe and effective in both obese and nonobese patients. In a recent study looking at the effects of obesity in TAR and ankle arthrodesis patients, the authors found that obesity was associated with increased rates of all complications, attributing this to increased rates of medical comorbidities, intraoperative factors, and larger soft-tissue envelopes (4). Schippers et al (5) retrospectively reviewed 49 obese and 48 nonobese patients who underwent TAR with a minimum follow-up time of 5 years. The obese patients had a significantly greater probability of implant failure at final follow-up time. Glazebrook et al (9) classified complications with TAR into 2 categories based on severity: high and low grade. Applying their classification to our results, we found that 10 patients in our cohort were classified with low-grade complications and 5 with high-grade complications (Table 3). The 10 low-grade complications were postoperative wounds to the anterior ankle that healed with local wound care, oral antibiotics, or both. There was 1 deep infection that led to below-the-knee amputation after multiple attempts at limb salvage.

A recent systematic review performed by Sansosti et al (10) discusses the effect of obesity on total ankle arthroplasty. The authors included 4 reports with a minimum 12-month follow-up time that met the inclusion criteria, 1 retrospective case series on obese patients, and 3 retrospective cohorts comparing patients with normal BMI to obese patients who underwent TAR. A total of 400 implants were included in the analysis. An overall complication rate of 17.8% (71 of 400) was encountered. The authors included complications that required revision surgery. This analysis differs from our report, because we included complications that did not require revision surgery as well as those that did.

We are aware that our study is not without limitations. One of the main pitfalls is that this is a retrospective review of cases by a single surgeon. Also, we did not compare the complication rates between the different total ankle replacement systems used; however, this is likely not relevant, as all ankle replacements were performed using an anterior approach. Another limitation of the study is the short-term follow-up duration. There was a minimal follow-up time of 12 months. This could lead to underreporting of postoperative complications, and rates could increase with a longer follow-up duration. One of the major complications occurred in a patient with a BMI of 49.5 kg/m^2. This patient experienced a peri-prosthetic fibular fracture that required open reduction and internal fixation 1 month after the index arthroplasty. Removing this outlier brings the total complication rate to 9% for the group of patients with a BMI >30 kg/m^2, thus indicating that a high BMI appears not to predispose a patient to complications.

We believe that some bias has been created in our study design by creating a dichotomy between 2 subsets of patients based on their BMI alone. Our study is limited in that it did not account for other confounders within the cohort. We studied a single variable, BMI, and focused on this solely. Other factors may have contributed to the occurrence of postoperative complications. This must be taken into consideration when interpreting our results. Finally, no outcomes scores were included, as this study focused solely on the complications and rates of complications associated with total ankle replacement.

As implant technology improves and surgeon experience increases, a much broader population of patients have become candidates for TAR. With earlier implant designs, increased BMI was considered a contraindication to ankle replacement for fear of accelerated implant failure. In the present study, there was no statistically significance difference in complication rates between the 2 groups. We found no implant failure leading to revision at the mean follow-up point of 26.3 months. Interestingly, the total complication rates were higher in group 1 with BMI ≤30 kg/m^2. It is the authors' collective opinion that the increased complication rate in this group was owing to the higher instance of wound complications, which, in turn, is likely because of the less robust soft-tissue envelope in the less obese patients, as most of the wound complications were found in group 1. Our findings are similar to those in the study by Gross et al (8) that showed no difference in complications between obese and nonobese patients who underwent TAR. We conclude that it is safe to consider TAR in patients with a BMI >30 kg/m^2, but <50 kg/m^2, and that the procedure can be performed with similar complications rates to that of patients with a BMI ≤30 kg/m^2 in the short term (Figs. 3 *A* and *B* and 4 *A* and *B*). In all patients, appropriate osseous and soft-tissue balancing procedures need to be performed to maintain the best possible outcomes.

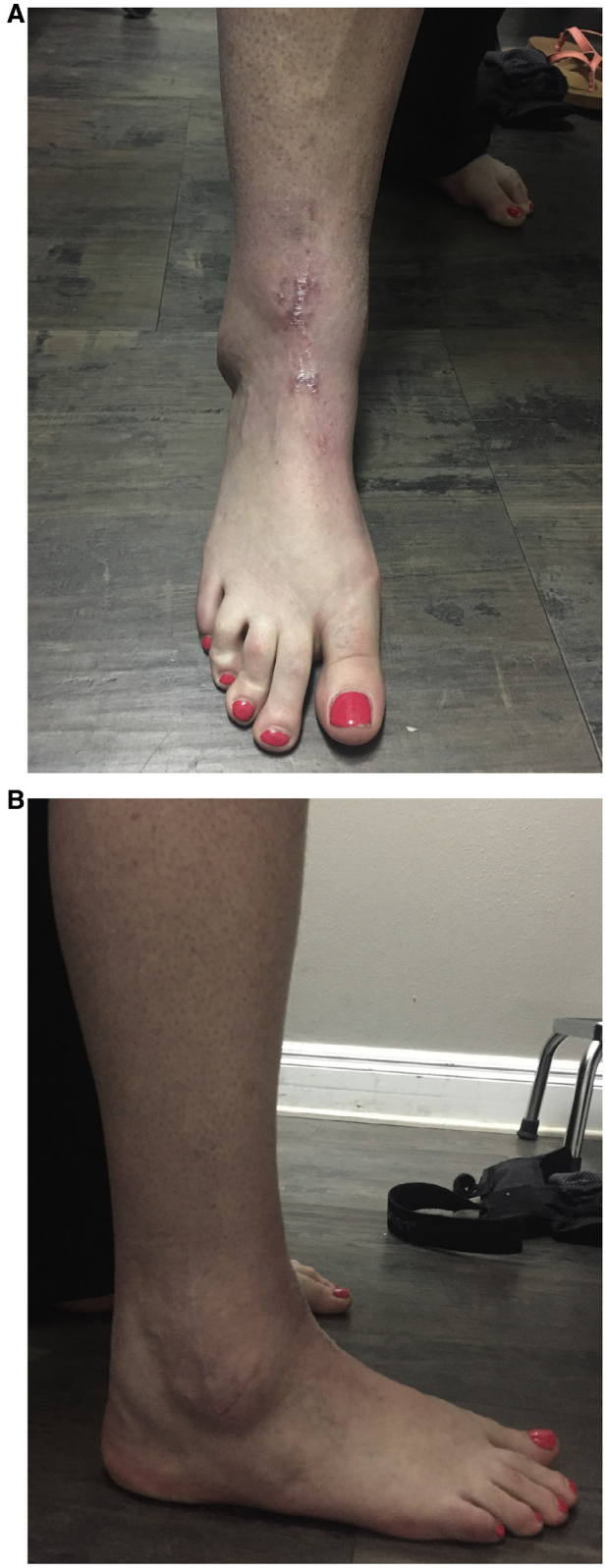

Fig. 3. (*A*) Clinical image of anterior ankle in a patient with a body mass index <30. (*B*) Clinical image of lateral ankle in a patient with a body mass index <30.

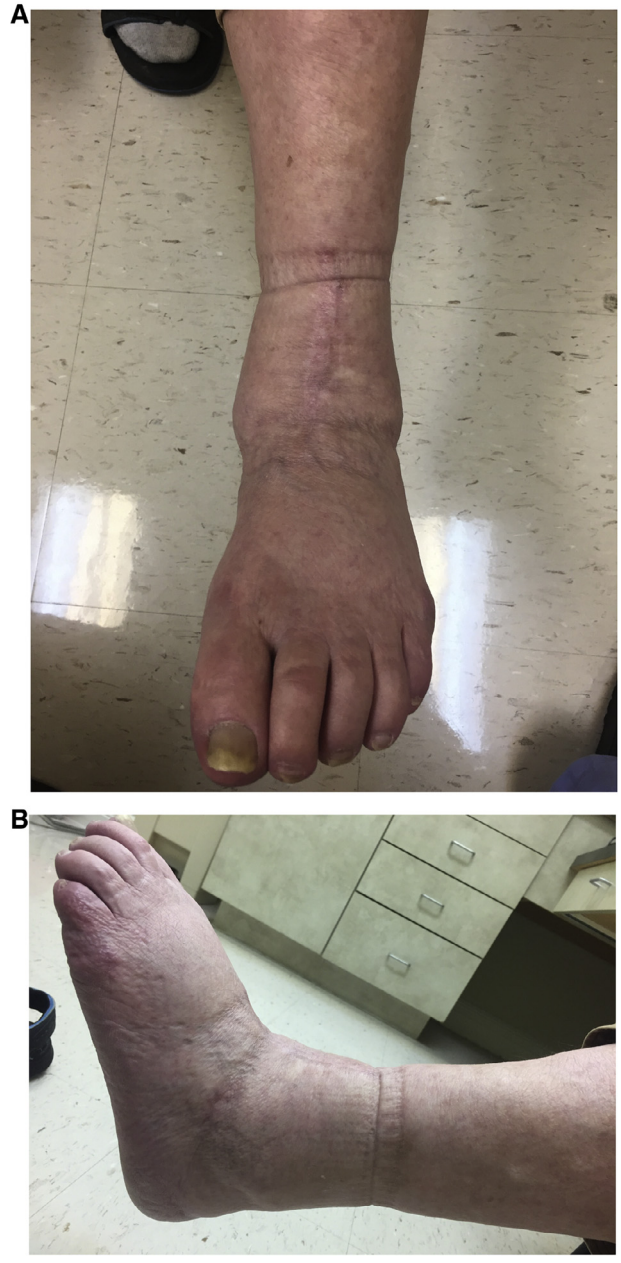

Fig. 4. (*A*) Clinical image of anterior ankle in a patient with a body mass index >30. (*B*) Clinical image of lateral ankle in a patient with a body mass index >30.

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