



## Preoperative and Postoperative Range of Motion: A Retrospective Comparison of Two Total Ankle Replacement Systems



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### ABSTRACT

The purpose of the present report was to compare the range of motion between a total ankle replacement requiring arched bony resection and a total ankle replacement requiring a flat cut for implantation. We hypothesized that the arched contour would more closely mimic the patient's pre-existing anatomy and increase the range of motion. Pain was evaluated as a secondary outcome. Twenty-eight patients (age  $55.95 \pm 15.29$  years) were included. Of the 28 patients, 14 were treated with an arch cut and 14 with a flat cut. Although no significant difference was found in dorsiflexion between the 2 implant groups ( $p = .38$ ), preoperative dorsiflexion, body mass index, implant type, and preoperative plantarflexion emerged as significant predictors of postoperative plantarflexion ( $p = .04$ ). This finding indicates that postoperative plantarflexion was significantly greater in patients treated with an arch cut ( $30.43^\circ \pm 10.01^\circ$ ) than a flat cut ( $21.79^\circ \pm 15.70^\circ$ ,  $p = .02$ ), when controlling for the other explanatory variables. A statistically significant improvement in pain was observed after total ankle replacement ( $p < .001$ ). The mean change in pain was similar for the 2 implant groups when statistically controlling for the follow-up duration ( $p = .09$ ). The findings from the present report suggest that plantarflexion significantly improves after total ankle replacement requiring an arched cut for implantation. Future studies should be designed to control for potentially confounding variables and assess the differences in range of motion after total ankle replacement.

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Since its inception, total ankle replacement (TAR) has been met with enthusiasm and resistance. The 1970s marked the introduction of total ankle implant designs as an alternative to arthrodesis. Although the initial results held promise, subsequent reviews with longer follow-up demonstrated less than ideal results (1,2). Success with proximal total joint replacement, namely the hip and knee, contributed to expedited designs in ankle prosthetics, which were wrought with flaws and failures. Premature implant failure was primarily attributed to poor implant design, loosening, and instability (3,4). Despite the initial optimism, the early proponents of TAR were

forced to advocate arthrodesis for its consistency and lower complication rate (5,6). Nevertheless, the search for a successful TAR persisted, leading to numerous generational modifications, including movement from constrained to less constrained designs (7,8).

To improve the survivorship of these advanced TAR systems, implants were designed to more closely mimic normal ankle anatomy and kinematics (9–14). Most promising, in 2011, Mann et al (11) demonstrated implant survival rates of 96% at 5 years and 90% at 10 years, with significant improvements in the American Orthopaedic Foot and Ankle Society ankle-hindfoot scores and pain scores. Considering these encouraging results, Mann et al (11) described TAR as an “excellent long-term option for treatment of ankle arthritis.” In 2010, a prospective multicenter trial was conducted comparing arthrodesis and arthroplasty, with a mean follow-up of 4 years (15). That study revealed that patients treated with TAR showed superior improvements in pain with similar clinical outcomes (15). Given the clinical relevancy of these findings, the popularity of TARs regained momentum, promoting the continual evolution of implant design.

Recently, a resurfacing TAR system, using a lateral transfibular approach for implantation, was approved by the Federal Food and

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**Fig. 1.** Total ankle replacement requiring arched bony resection for implantation. An anteroposterior radiograph showing the semiconstrained, 3-component total ankle replacement.

**Drug Administration.** This novel TAR system is implanted with an alignment guide, which encourages an arched, anatomic contour. Presumably, the arched contour lends greater anatomic positioning of the implant and increased range of motion. Therefore, the purpose of the present study was to compare the range of motion between this new-generation prosthetic (Zimmer® Trabecular Metal™ Total Ankle, Warsaw, IN; Fig. 1) and a TAR system requiring a flat cut for implantation (INBONE®, Total Ankle Replacement; Wright Medical Technology, Inc., Arlington, TN; Fig. 2). As a secondary outcome measure, pain was compared between the 2 TAR systems.

#### Patients and Methods

##### Aims

The primary aim of the present study was to compare the preoperative and postoperative range of motion between 2 new-generation implants. We secondarily aimed to compare the amount of pain between the 2 implant groups.

##### Assessors

All patients were treated by the senior surgeon (S.A.B.). A medical record review was performed by 3 of us (J.L.M., N.M.P., and G.M.W.). The contributory patient demographics and comorbidity data were recorded. These consisted of patient age (years), gender (male or female), body mass index (BMI) ( $\text{kg}/\text{m}^2$ ), operative limb (left or



**Fig. 2.** Total ankle replacement requiring flat bony resection for implantation. An anteroposterior radiograph of the modular stem, fixed-bearing total ankle replacement.

right), diagnosis (primary or osteoarthritis, post-traumatic arthritis, rheumatoid arthritis), the presence of cancer, cardiac conditions, diabetes mellitus, gout, hypercholesterolemia, hypertension, hypothyroidism, obesity, and smoking status.

##### Study Population

For inclusion, the patients were  $\geq 18$  years of age, had been diagnosed with end-stage ankle joint arthritis, had exhausted conservative treatment, and had undergone surgical treatment with either the TAR system requiring an arched cut or the TAR system requiring a flat cut for implantation. All the patients underwent surgery by the senior investigator (S.A.B.) between July 2008 and September 2013. Implant selection was determined by the patient's activity level, ancillary procedures, and/or deformity correction required at total ankle arthroplasty. Patients were excluded if the preoperative or postoperative range of motion (dorsiflexion, plantarflexion) data were missing from their medical record. Our institutional review board approved the protocol and waived the requirement for informed consent. The data were recorded into a password-protected secure database. The confidentiality and privacy of the patients was ensured and maintained.

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