Revision Total Ankle Arthroplasty with Tibial Stem Component Using Antegrade Tibial Reaming: Technique Guide and Case Study

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Title: Revision Total Ankle Arthroplasty with Tibial Stem Component Using Antegrade Tibial Reaming: Technique Guide and Case Study

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Abstract:
Complications after total ankle arthroplasty can be difficult to treat with limited viable options. Often, companies have described product revision techniques using larger components and tibial intramedullary stems to increase contact surface area while increasing stability. Revision techniques for tibial stemmed components normally call for retrograde reaming via access into the intramedullary canal of the tibia through both the talus and the calcaneus. However, this creates a challenge for the foot and ankle surgeon when the talar component is stable and does not require revision. In this study, we present a novel technique using antegrade reaming for revising a failed tibial component to a stemmed implant while maintaining the original, stable talar component. We also highlight our case study in a patient who has had this technique performed.

Level of Evidence: V

Key Words
Anterograde, revision total ankle arthroplasty, revision total ankle replacement, stemmed implant, talar component, tibial component,

Introduction:
Total ankle arthroplasty (TAA) continues to gain popularity as a viable alternative to ankle arthrodesis in the setting of ankle arthritis. Over the past couple of decades, improvements
have been made to implant design, implant materials, and surgical technique allowing for increased longevity of the implant as well as improved patient outcomes (1). Additionally, the indications for implantation have also been challenged over the years including younger average patient age and increased degree of deformity. As the prevalence of TAA increases and the boundaries for implantation continue to be pushed, so does the likelihood of complication or need for further surgery and revision of the primary implant (1,2,3).

Advances in revision implant design today have aided surgeons in successfully completing revision cases with an increased demand for operative technique strategies for revision TAA (4). Literature is sparse on the long-term outcomes of converting a failed TAA system to another system or revision system. Recent studies have shown that revision TAA has a high risk of perioperative complications including postoperative implant dislocation, intraoperative fracture, and wound dehiscence (4,5).

To the best of our knowledge there is a lack of published research on the techniques for implanting a stemmed tibial system when the talar component is stable and can be left intact. Therefore, the goal of this paper is to detail our surgical technique and present a case study of a patient who underwent antegrade tibial reaming for revising a failed tibial component to a stemmed implant while maintaining the original, stable talar component.

**Surgical Technique:**

Patient should be placed in supine position with the operative leg elevated from the contralateral leg. Care should be taken to prep and drape above the knee joint. A standard
anterior ankle incision should be utilized to gain access to the ankle joint. Once the current implant is exposed, the implant component stability should be assessed. Once confirmed that the tibia component is loose and unstable, but the talar component remains stable, the current polyethylene and tibial component should be removed making sure to not damage the talar component. Once the polyethylene and tibial component are removed, check to confirm again that the talar component is stable.

At this point, attention is directed just medially to the lateral tibial spine. A 5-cm incision is made directly over the anterior proximal tibial tubercle. We would recommend utilizing a sterile trauma triangle to aid in positioning of the knee and tibia in preparation for antegrade tibial reaming. Utilizing fluoroscopy, a guide wire is inserted and advanced distally down the tibial canal until it is visualized at the level of the ankle joint (Figure 1A-B). The guide wire is then clamped within the ankle joint to maintain its position within the tibial canal (Figure 1C). The canal is reamed in an antegrade fashion to a size 14-mm reamer distally into the ankle joint (Figure 1D). Care should be taken to protect the talar component throughout this process. The tibial reamer is then removed, and the proximal tibial incision is closed to the surgeon’s preference.

Next, the patient is placed into the extramedullary alignment guide specific to the stemmed tibial implant. The position along with tibial component size are confirmed on fluoroscopy (Figure 1E). At this point, the tibial resection cuts are created, and the tibial bone is removed from the operative field followed by placement of the trial tibial component to confirm sizing. Next the intramedullary stem is constructed and then placed into the distal tibial canal. Since
this technique does not allow for the traditional implantation driver device, as this would traditionally be introduced through the calcaneus and talus in retrograde fashion, we recommend building as much of the stem on the back table prior to insertion into the tibial intramedullary canal through the anterior ankle opening. Then utilizing a combination of clips and wrenches, construct and implant the rest of the tibial stem into the tibial canal through the ankle joint space. This is followed by the tibial tray which is seated into the morse taper and impacted into the distal tibial utilizing the Offset Tibial Tray Impactor from the primary TAA instrumentation set.

Finally, polyethylene components are trialed assessing appropriate coronal stability and range of motion. The appropriately sized polyethylene is seated into the tibial tray and the ankle joint should be taken through range of motion. The ankle is then closed in a layered fashion according to the surgeon’s preference.

Postoperatively, we utilize an accelerated weight bearing protocol for our TAA patients; however, patients are assessed on a case-by-case basis dependent on any adjunctive procedures, their history, and home situation. Traditionally, they are placed into a well-padded splint and made non-walking, however we do allow stationary heel weight bearing for the first 2 weeks. Then, once the incision is healed and sutures are removed, they are transitioned to protected weight bearing in a walking boot for an additional four weeks and start with physical therapy. Patients transition to shoe gear at week six.

Case Study:
A 75-year-old male with end stage ankle arthritis presented to the senior author’s clinic (J.N) with continued ankle pain. He had been trying conservative treatments for quite some time without any relief in his discomfort and disability. Radiographically, the patient had asymmetrical joint space narrowing with intra-articular incongruity and valgus talar tilt. There was noticeable subchondral sclerosis with osteophytic adaptations most notably within the medial and lateral gutters (Figure 2A-D). The patient underwent a primary TAR using a 4th generation fixed bearing implant with the addition of a gastrocnemius recession as well as a lateral ankle ligament reconstruction (Figure 3A, B).

Patient was doing well in the postoperative period and was transitioned to protected weightbearing in a walking boot at two weeks with physical therapy. He returned six months postoperatively with ankle pain and deformity. Patient noted a “pop” in his ankle with immediate new onset of pain. Radiographs revealed talar component migration, necessitating revision (Figure 4A-C). His previous components were revised with a revision talar component due to talar bone stock and a primary tibial component (Figure 5A, B).

Four months after first revision surgery and against medical advice, the patient began performing heavy manual labor and subsequently had a new onset of pain and deformity noted. Advanced imaging demonstrated a loose tibial component with anterior tibial subsidence. However, despite tibial subsidence, the talar component was stable (Figure 6A-B). At this time, a decision was made for another revision procedure.
As noted, the patient had a stable talar component and therefore the decision was made to attempt antegrade reaming for the stemmed tibial component keeping the talar component intact. As demonstrated in Figure 1, antegrade reaming of the tibia was performed and placement of a tibial stemmed component was successfully achieved. Patient received a stemmed tibial component and retained his original talar component (Figure 7A, B)

Patient is now 27 months post-operative from repeat revision TAR and has had no associated complications (Figure 8A-C). He is able to ambulate without the assistance of any devices, able to perform his daily activities, and reports an improvement in patient related outcome measures.

Discussion:
Revision of a failed total ankle arthroplasty (TAA) remains a challenge today for even the most skilled of foot and ankle surgeons. In the literature, the main complications inherent to total ankle replacements that warrant a revision include aseptic loosening, post-operative fracture, deep infection, implant subsidence and implant failure. It has been shown that anywhere from 10-20% of primary TAA require revision within five years (6).

There are only a few limited series reporting on treatment options and outcomes for revision TAA. Lachman et al. examined 52 patients who underwent revision at a follow-up of 3.1 years on average. At the time of most recent follow-up 41/52 (78.8%) had successful revision while 11 (21.2%) were considered failed revisions. Of these 11 failures, 5 (45.5%) went on to successful revision of their revision TAA, and at the conclusion of the study still had implants in
place (7,8). In another study, Lachman retrospectively reviewed 29 patients with failed primary total ankle arthroplasty who underwent revision. At 3.3 years post-op from revision, 26/29 (89.7%) retained their initial revision implants. One patient who underwent a second revision surgery, retained their revision components at 18 months post-op (7,8).

Hinterman et al. reviewed 117 revision TAAs using a non-constrained, 3-component system that includes revision components and custom implants. They reported an average time to revision of 4.3 years and 15% re-operation rate of revision TAAs with aseptic loosening being the most common cause (9).

Tennant et al. evaluated the risk of injury to the talar arterial associated with specific total ankle arthroplasty implants. Of the 11 patients that experienced failure of their primary TAA, 5 patients underwent revision with a stemmed implant. Of these patients who were revised with a stemmed implant which required subtalar drilling to access the tibial canal, all developed some grade of talar avascular necrosis. When this was evaluated looking at cadaveric specimens, they found that three of four cadaveric limbs that underwent subtalar drilling for stemmed tibial implants had direct transection of the artery of the tarsal canal (10). Through our technique of anterograde reaming for a stemmed implant, we hope to show an alternative technique to avoid this injury to the talar blood supply.

With the continued improvements and innovations to implants, they continue to allow for less bony resection, more anatomic designs, and increased stability which hopefully will continue to enhance short and long term patient reported and radiographic outcomes (4). When
considering revision options for TAA, the amount of bony real estate is important to appreciate in both the tibia and talus. Traditionally with each revision that a patient endures, the more bone from their tibia and talus gets resected. Without adequate bony real estate in the tibia and or talus, this limits their future revision options whether it be fusions or replacements.

Here we demonstrated a successful technique for complex revision utilizing antegrade reaming for the stemmed tibial component while retaining the original stable talar component. The benefits to this technique are multifold. Most importantly, this technique eliminates the need for further talar bony resection allowing for more real estate in the talus to support the current talar implant as well as for any future revisions needed. The more bone resected from the talus and tibia the higher the chance of subsidence. We present a case study of a patient who is now over two years from his second revision where antegrade reaming for the tibial component was used in order to allow retention of his talar implant and the patient continues to be able to perform his daily activities without inhibition.

As the utilization of total ankle arthroplasty continues to exponentially increase in foot and ankle surgery, there is increased necessity for operative technique strategies for revision procedures. To the best of our knowledge, the above technique is the first to allow for retention of a stable talar implant while still allowing for the use of a stemmed revision tibial implant.

**Financial Disclosures:**

Helene R. Cook, DPM, AACFAS; Collin Messerly, DPM, AACFAS: have no financial disclosures, commercial associations, or any other conditions posing a conflict of interest to
Garret Strand, DPM, AACFAS reports he is a consultant for Enovis/DJO. Jason Nowak, DPM, FACFAS reports he is a consultant for Paragon, Exatech, Wright, and Enovis/DJO. Matthew Herring, MD reports he is a consultant for Enovis/DJO.

Informed Consent

Informed consent was obtained from the patient for the publication of this study and accompanying images.

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Informed Patient Consent

Complete informed consent was obtained from the patient for the publication of this study and accompanying images.

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Figures Legend:

Figure 1: A. Guide wire inserted at tibial tubercle; B. Guide wire is advanced into the ankle joint; C. Guide wire clamped in the ankle joint to maintain position within the canal; D. Anterograde reaming; E. Patient placed into alignment guide and position of implant confirmed.
Figure 2 - A: Anteroposterior ankle radiograph showing asymmetrical joint space narrowing with slight incongruity at the ankle and valgus talar tilt; B: Oblique ankle radiograph further showing subcondral sclerosis and osteophytic adaptations to the medial and lateral gutters; C: Anteroposterior foot radiograph showing neutral foot structure; D: Lateral radiograph also showing neutral foot structure.
Figure 3 - A: Lateral ankle, B: anteroposterior ankle immediate post op views.

Figure 4 - A: Anteroposterior, B: oblique, C: lateral ankle radiographs at the patients 6 month follow up appointment. There is notable talar component migration.
Figure 5 - A: Lateral ankle, B: Anteroposterior ankle immediate postoperative radiographs utilizing a revision talar component.
Figure 6 - A: Ankle oblique and B: Lateral ankle radiographs four months post operatively. There is loosening at the tibial component with superior displacement and subsidence of the anterior portion of the component. Talar component appeared to remain stable.

Figure 7 - A: Anteroposterior and B: lateral ankle immediate post-operative radiographs. Original talar component was retained and anterograde reaming was performed for the revision tibial component.
Figure 8 - A: Oblique, B: Anteroposterior, and C: lateral radiographs at one-year post revision to tibial stemmed implant. Implant without any failure, lucency or subsidence.