Conversion of hindfoot intramedullary nail arthrodesis to total ankle arthroplasty: A case study

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Ankle arthrodesis has long been the gold standard for ankle arthritis but issues such as adjacent joint arthritis, non-union, and malunion are common complications. Total ankle arthroplasty (TAA) has gained popularity with recent encouraging long-term results and conversion of ankle arthrodesis to arthroplasty is now being offered. This case study reports a total ankle arthroplasty conversion from a retrograde hindfoot intramedullary nail in a 25 year old female with a history of trauma and several operations. This case describes a rare instance for this particular procedure due to the arthrodesis performed by an intramedullary hindfoot nail complicated by malunion.

Keywords: ankle arthrodesis, ankle replacement, fusion conversion, hindfoot nail

To the authors’ knowledge, this is only the second reported conversion that involved a hindfoot nail and the only report involving a hindfoot nail to Inbone Total Ankle System (Wright, Memphis, Tennessee).

Case Study

In 2016, a 21 year-old African American female initially presented to the Emergency Department following a motor vehicle collision. Radiographs obtained revealed a right Hawkins Type III talus neck fracture and a medial malleolus fracture. Neurovascular status was confirmed to be intact. The surgeon initially treated the patient with open reduction and internal fixation (ORIF) and application of external fixation in a delta frame configuration. After a seven-week period, the patient underwent removal of the external fixation.

Two years after the initial injury, the patient presented with subsequent right ankle pain. Radiographs revealed adequate bone healing and apposition with no hardware failure. A CT scan obtained revealed a 10mm x 10mm osteochondral lesion on the lateral aspect of the talar dome. The surgeon performed microfracture of the osteochondral lesion by means of ankle arthroscopy.
Three years out from the initial injury and 5 months after the second surgery, the patient still suffered with right ankle pain, the initial surgeon referred the patient for a second opinion. The referred surgeon found continued pain with decreased range of motion and radiographic signs of post-traumatic arthritis. The patient elected to undergo an ankle arthrodesis procedure of her right ankle. After removal of previous hardware, ankle arthrodesis was performed utilizing screw fixation and a fibular on-lay graft technique was performed.

Eight months after undergoing a right ankle arthrodesis procedure the patient presented back to the clinic with a complaint of pain at the medial aspect of the right ankle. Radiographs revealed prominent hardware and the patient elected to undergo hardware removal.

Eighteen months from undergoing arthrodesis of the right ankle, the patient still presented with a painful right ankle. Radiographs revealed nonunion of the arthrodesis site. The surgeon opted to perform a revision arthrodesis with a retrograde intramedullary hindfoot nail and placement of a cancellous graft obtained from the ipsilateral tibia into the tibiotalar joint.

Now 4.5 years out from the initial injury, 8 months from a retrograde hindfoot nail, the patient was referred to the main author. Physical exam revealed an inability to walk due to a fixed plantarflexed right ankle deformity. Radiographs (Figure 1) showed placement of retrograde intramedullary hindfoot nail in plantarflexed malunion at the ankle joint. After an in depth discussion with the patient of the malposition of the intramedullary nail and risks of reoperation, the patient elected for removal of the intramedullary nail with the intention of eventual conversion to a total ankle arthroplasty. Removal of the intramedullary nail was performed and bone deficits were filled with a demineralized bone matrix (Figure 2). Four months after undergoing removal of the intramedullary nail, the patient returned to the operating room for a total ankle arthroplasty utilizing the Inbone Total Ankle System (Figure 3). Intraperoperatively, complete arthrodesis was appreciated at the ankle joint. After insertion of the Inbone Total Ankle System and a percutaneous tendo-Achilles lengthening, range-of-motion performed intraoperatively was present and dorsiflexion to neutral was obtained.

![Figure 1 AP & lateral radiographs of ankle arthrodesis with subtalar joint fusion.](Image)

During the postoperative course, the patient developed dehiscence of the incision site and required local wound care. The patient underwent wound debridement and application of a skin graft substitute and continued local wound care. After 10 weeks of local wound care and proper offloading, the wound site healed. The patient was allowed to ambulate during this period utilizing a CAM boot on the right lower extremity.
At six months follow-up, the patient described satisfactory results from the procedure and was able to fully ambulate in supportive shoe wear. Prior to the TAA, the patient was using a knee scooter for ambulation. Radiographs at 6 and 12 months after the procedure exhibited ankle implants in proper alignment without signs of subsidence or implant failure. The 12-month follow-up radiographs (Figure 4) showed asymptomatic medial gutter heterotrophic ossification.

**Discussion**

Ankle arthrodesis has long been the gold standard for ankle arthritis. After undergoing an AA patient may still have pain stemming from the ankle which could be due to malunion, nonunion, or improper positioning. Another major complaint of patients after undergoing AA is progressive arthritis in adjacent joints whether proximal or distal to the ankle. There is developing literature that patients with subsequent pain after AA may benefit from conversion to a TAA [6,7]. Coetzee, et al., [8] in 2020 published findings after performing TAAs on 52 ankles and found statistically significant improvement in Ankle Osteoarthritis Scale Pain, Ankle Osteoarthritis Scale Disability, and VAS Pain scores with an overall patient satisfaction rate of almost 90%.

In 2015, Pellegrini [9] and others, performed a TAA in 23 ankles in patients who had undergone a tibiotalar arthrodesis with a mean follow-up of 33.1 months. Two of the 23 patients had their lateral malleolus resected at the time of fusion, these patients required an allograft fibula when undergoing conversion. Both of these ankle replacements failed. They did find significant improvement in the VAS
pain score with a mean preoperative value of 65.7 and a mean postoperative value of 21.8. 5 of their patients reported being pain free at final follow-up. They found improvement in the SF-36 total score from 37.7 to 56.4. The final ROM was reported as 21.9 degrees. Twenty of the twenty-three patients had their metal implants retained at time of final follow-up.

The case study presented consisted of an AA utilizing a retrograde hindfoot nail. To the authors’ knowledge only one case of retrograde hindfoot nail AA conversion to a TAA has been reported. Atkinson, et al.,[10] reported removal of a hindfoot nail and placement of Hintegra (Allegra Orthopaedics, Lane Cove West, NSW) mobile bearing implant. There was two years between removal of the nail and the TAA. The nail was removed due continued pain in the proximal tibia after stress fracture had healed. The patient was reported to be subjectively happy with increased function, symptom improvement, and increased balance. They performed a gait analysis which showed normalization of gait mechanics, increased walking pace, increased stride length, and increased cadence. Our case of TAA conversion was also staged, however, only four months before implant placement.

Converting a hindfoot nail to TAA may complicate implant placement and integrity of distal tibia due to void from nail. The patient reportedly had a 11mm x 200mm Stryker supracondylar femur nail placed in retrograde fashion through the rearfoot. Surgical implantation of the nail included reaming the intramedullary canal to 12.5mm. Implantation of the Wright Medical Inbone Total Ankle System required reaming the intramedullary canal of the distal tibia to 16mm with use of two 16mm tibial stem components and an 18mm base stem component. In addition to allowing four months of post nail removal, the canal required greater than 12.5mm of reaming which in theory should not affect implant stability. The Inbone implant was selected due to the intramedullary void as reaming is necessary and other low profile tibial components would likely affect component stability and ultimately may lead to failure [11].

In 2013, Rodrigues-Pinto and colleagues [12] aimed to look at survivorship and early to medium-term results between young and older patients. They pulled 103 patients from an ongoing prospective multicentric study. They had a mean follow-up of 41 months. They divided their patients in two groups. Group 1 consisted of patients less than 50 years of age with a mean age of 43 and a range of 24-49 years of age. Group 2 consisted of patients older or equal to 50 years of age with a mean age of 61 and a range of 50-81 years of age. The primary diagnosis was post-traumatic arthritis in both groups. They found a significant increase in AOFAS scores for both groups from their preoperative value. The younger than 50 group was noted to have a significant increase in their AOFAS score, 66.8 versus 62.8 in the greater than 50 group. There was a significant increase in ROM for the less than 50 group when compared to the greater than 50 group. Rodrigues-Pinto conclusion was that at medium term, ankle replacement is at least as effective in patients under 50 when compared to those 50 or older. They also found no significant difference in survivorship rates between both groups. The younger than 50 had a 93.5% survivorship rate and was 93.1% in patients with 50 years or above. Our patient was 25 years of age at implantation of TAA, literature has shown patients as young as 24 years of age receiving TAAs [12-15].

Conclusion

Conversion of AA completed by a hindfoot nail to TAA is absent from the current literature with the exception of a single case study [10]. This is only the second report of such a conversion and the first using the Inbone Total Ankle System. The stem component of the Inbone implant was selected due to the intramedullary void from the nail and has proved stable from its intraoperative implantation to 12 month follow-up. The case study exhibits a younger patient that pushes the lower limit of TAA implantation, however, our patient was faced with severe trauma, multiple surgeries, and was unable to ambulate at time of consultation. Removal of an retrograde intramedullary nail for placement of a TAA will likely remain a rare scenario as nails are often salvage or end-stage procedures but in rare cases can be explored as our case study has exhibited. Further follow-up will be necessary to acquire survivability of the implant and the patient’s satisfaction.

References
