Time to Straighten You Out: Gradual Deformity Correction of Tibial Varum with One Stage Total Ankle Replacement for Ankle Joint Degeneration

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Statement of Purpose

Lower extremity deformity is a common cause of ankle joint osteoarthritis. To our knowledge, there are no cases reported in the literature of a gradual correction of a tibial varum deformity with a one stage total ankle replacement. This study provides our protocols on simultaneous repair of both tibial and ankle deformities through a CT guided ankle replacement and external fixture bone transport software.

Literature Review

Patients with end-stage ankle arthritis are presented with either joint sparing or joint destructive procedures. The difficulty of this decision increases exponentially when faced with a proximal limb deformity. Since such deformities lead to significant impact of the structures distal to it, one would believe that a failure to correct the deformity would lead to implant failure. Ankle replacement was primarily indicated for patients with minimal to no frontal plane deformity, which limited these patient's options for relief. The most common pathology leading to ankle replacement is post-traumatic arthritis, frequently associated with a varus deformity.[1] If the proximal deformity is not corrected while an implant is being utilized, component loosening, accelerated polyethylene wear, and mechanical failure will follow. Deforth et al reported on 22 patients who underwent a total ankle replacement without correction of the proximal varus deformity. These resulted in significant pain in the ankle joint as well as increased implant wear and failure. All were relieved by a supramalleolar osteotomy (SMO), where some had to have replacement of the polyethylene spacer.[2] Trajkovski et al compared 36 patients with a more than 10 degree coronal various tilt and 36 patients with less than 10 degree deformity. All underwent total ankle joint replacements. In those with a significant deformity (more than 10 degrees), the replacement components underwent significant wear of the implant, with eventual replacement/revision.[3] When performing these procedures, the goal is to align the osteotomy as close to the center of rotation of angulation (CORA) as possible. This maximally decreases the deforming forces that are present on the ankle joint and realigns the center of the ankle joint for proper biomechanical function.[4] Multiple techniques are employed for SMOs, including lateral based and medial based wedge resections/openings, and dome osteotomies. The consensus of the literature seems that preoperative deformities in cases of degenerative ankle joint disease could be corrected in more than 85% of cases when other soft tissue and bone procedures are performed.[1] After review, the literature present today does not discuss the use of an external fixator application to aid in the correction of a tibial deformity while replacing the ankle joint in a one step procedure. The importance of the external fixator use is that the computer based system provided allows the surgeon to perform gradual correction.

Case Study

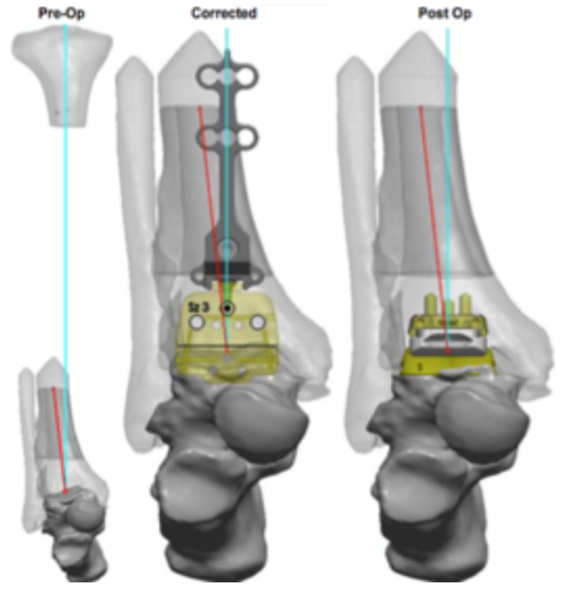
A 64 y/o male presented with degenerative joint disease of the right ankle and pain present for three years. Furthermore, the patient was involved in a motor vehicle accident 30 years prior to presentation where he suffered fractures of his right tibia, fibula, and femur. He had a history of coronary artery disease and had a catheter placement in 2007. His other surgical history included ORIF of the right tibia/fibula/ femur from the MVA, and a rotator cuff repair. He was on chronic pain medications to alleviate symptoms. He had NKDA and was a 20 pack year smoker who ceased in 2005. He denied illicit drug use and consumed alcohol socially. Musculoskeletal exam revealed a significant tibial varum deformity of approximately 15 degrees s/p MVA, with end-stage DJD and limited range of motion of the right ankle. Furthermore, a limb length discrepancy was present, with the right limb approximately 3cm shorter than the left limb. His neuromuscular status was intact, and the remaining physical examination was otherwise unremarkable.

The patient underwent a phasic correction change with a Wright Medical Infinity Total Ankle replacement along with a tibial and fibular osteotomy. A TL-Hex Hexapod was placed to gradually correct the tibial varum. The talar and tibial bone cuts were made in line with the ankle joint. This was done because there was fear that, if the implant was solely relied on to help obtain correction, that it would ultimately lead to implant failure. Postoperative correction was obtained via the external fixator for a period of 50 days. At 8 weeks postoperatively, the foot plate for the ex-fix was removed and physical therapy was initiated for ankle range of motion.

The patient had the TL Hex frame on for 120 days. It was subsequently removed after adequate consolidation was observed on bot x-ray and CT scan evaluation. At the same time of removal, an open Achilles tendon lengthening with manipulation of the ankle under fluoroscopy was performed. After this surgery, the patient was placed in a below knee fiberglass cast for 4 weeks. He was then transitioned to a fracture boot and was allowed to be WBAT to right foot with boot and crutches. After 8 weeks s/p removal of ex-fix, the patient was transitioned to WBAT in a custom patellar tendon bearing brace. After 3 months of using the brace, he was transitioned to a supportive shoe. At this point, the tibial osteotomy had completely healed with trabeculation across the osteotomy site and minimal bone callous formation. The ankle implant appeared well incorporated with no evidence of hardware failure. At the one year follow-up, he was observed to have normal gait and was completely pain free. He was able to perform his daily activities without difficulty. No pain of ankle joint was present during manipulation, and the patient was left with 5 degrees of available dorsiflexion.

Figure 1: Radiographs revealing RLE limb length discrepancy with tibial varum

Figure 2: Degenerative Joint Disease of R ankle



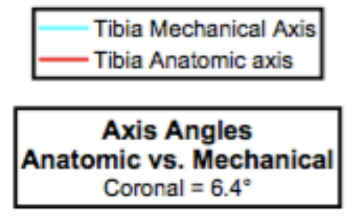


Figure 3: INFINITY Size 3 Long Tibia & Size 3 INFINITY Talus Anterior Views. Medial/ lateral placement is set to match medial corner, leaving adequate bone coverage on lateral portion

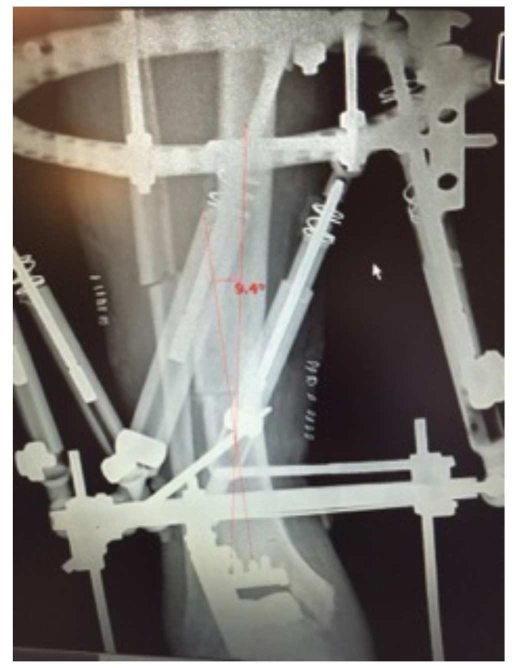


Figure 4: S/P SMO and Hexapod application

Figure 5: Increase in length to offset LLD

Figure 6: (A) Lateral and (B) AP view both showing increased bone formation and decrease in deformity with no failure of implant

Figure 7 (Left): Postoperative clinical view of the Hexapod system. Stabilization ring noted proximally, with middle and distal rings centered to correct the varus deformity

Figure 8: (A) Lateral and (B) AP views showing healed osteotomy site correcting for the deformity and intact ankle implant

Discussion

Surgical intervention for ankle replacement is vastly growing in popularity, but becomes increasing difficult when a proximal leg deformity is present. Lower limb deformity correction has advanced significantly with the use of computer guided software. This allows for meticulous calculation to perform gradual correction. Ankle joint replacement has improved with the use of CT guided cutting blocks, which increase the precision of the surgery and increase the predictability of outcomes.

Tibial osteotomies can be a vital part in the prevention or treatment of early degenerative changes in the ankle. When the progression of the arthritis has become significant, joint destructive or joint sparing procedures are discussed. If a joint destructive procedure is elected, the likelihood of arthritis developing in other joints of the foot increases. If an implant is used, this likelihood of arthritis decreases. Supra-malleolar osteotomies are performed to help realign the distal tibia and improve foot and ankle function. This combined with total ankle replacement can lead to pain relief and improved clinical outcomes in patients with end stage ankle arthritis. In this case, correction of the deformity of the distal tibial was achieved with a SMO, helping us obtain a well aligned ankle joint replacement.

The purpose of this case presentation is to demonstrate the ability to address a tibial and ankle deformity through CT guided ankle replacement and external fixation bone transport software. The varus arthritic ankle can be corrected and balanced in a systematic fashion intraoperatively with use of the hexapod and it's associated computer software. According to our research, no previously reported case presentation has been published using the method presented.

References

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