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CASE STUDY: 1
INFINITY® Total Ankle Replacement System with PROPHECY® Preoperative Navigation Guides in a Patient with Post-traumatic Ankle Arthritis

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These results are specific to this individual only. Individual results and activity levels after surgery vary and depend on many factors including age, weight and prior activity level. There are risks and recovery times associated with surgery, and there are certain individuals who should not undergo surgery.
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Patient History

The patient presented as a healthy, physically fit 64-year-old female with a BMI of 25. She reported that she enjoys skiing and horseback riding, but was no longer able to do these activities due to severe left ankle pain. At age 16, she had a left distal tibia fracture that was treated with casting (FIGURES 1A and 1B). The fracture healed, and she did not have a problem with the ankle for many years. Over the past five years, the patient began to experience gradual onset of left ankle pain, which she described as “severe” at the time of presentation. Previous treatment for the pain included NSAIDs, an ankle brace, and a cushioned, rocker-sole shoe. Corticosteroid injection provided good pain relief, but only lasted for about six weeks.

Examination

At presentation, the patient walked with a mild limp favoring her left side and had a walking tolerance of about one block. Her left ankle pain was localized to the anterior portion of her ankle, with pain also present medially and laterally. Her pain was worse with dorsiflexion and when walking on uneven surfaces. The left foot was neutral in appearance and alignment. The ankle had a range of motion of 0° degrees dorsiflexion and 30° plantarflexion. She had full range of motion at the subtalar joint, with no pain or tenderness in that area.

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Imaging and Diagnosis

AP and lateral standing ankle x-rays (FIGURES 2A and 2B) show end-stage arthritis with neutral intra-articular alignment and no adjacent hindfoot arthritis (COFAS Type 1). A left ankle CT scan (FIGURE 3) shows advanced ankle arthritis with no subtalar arthritis.

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Case Assessment

The patient had significant ankle pain and dysfunction. She failed nonoperative treatment, therefore surgical treatment was warranted. The patient’s age, activity goals, low BMI, and neutral foot alignment made her a candidate for either ankle arthrodesis or arthroplasty. After extensive discussion, and in view of her activity goals and reasonably preserved ankle range of motion, the patient elected to undergo total ankle arthroplasty with the INFINITY® Total Ankle Replacement System.

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Preoperative Planning

PROPHECY® Preoperative Planning Guides were used to optimize implant position and ensure that any deformities resulting from the previously fractured tibia would be accounted for by aligning the tibial component to the mechanical axis (blue line shown in FIGURE 4). A 3° correction of the talus varus angle was incorporated into the patient-specific plan (FIGURE 5).

Due to the surgeon’s preclinical evaluation, which showed good ankle range of motion and excessive wear of articular cartilage, the PROPHECY® Preoperative Plan incorporates smaller bone resections (per the surgeon’s recommendation) in order to restore joint height.

FIGURE 4:
AP view of PROPHECY® preoperative planning. The blue line illustrates the mechanical axis and was used to set the coronal alignment for this case. The red line represents the patient’s distal tibial anatomic axis.

FIGURE 5:
Detail of PROPHECY® talar resection planning.
Surgery
A standard anterior surgical approach was used. The patient-specific PROPHECY® Guides were used for both the tibial and talar cuts. The procedure was completed with INFINITY® Total Ankle instrumentation following the standard surgical technique. Excellent implant positioning and seating were confirmed with intraoperative fluoroscopy (FIGURES 6A and 6B).

FIGURE 6A and 6B:
Intraoperative fluoroscopic images showing excellent implant placement using the PROPHECY® guides.

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Postoperative Care

The patient was placed in a well-padded plaster splint before leaving the operating room. She remained splinted and non-weightbearing for two weeks.

2 Weeks Postop

At 2 weeks postop, the splint and sutures were removed, and the patient was placed in a below-knee walker boot. A physiotherapist in the clinic assessed the patient and provided instruction on gentle range-of-motion ankle exercises. The patient was allowed to begin weightbearing in the walker boot as tolerated.

6 Weeks Postop

At 6 weeks postop the walker boot was discontinued, and a vigorous physiotherapy program was initiated. The patient was instructed on a progressive return-to-function program over the next six weeks.

12 Weeks Postop

At 12 weeks postop, the patient was allowed full return to function. She was instructed to avoid activities that risked falling, vigorous twisting, or repetitive impact of the ankle. The patient was instructed to return annually for reassessment with x-rays.

1 Year Postop

The patient is currently at 1 year postop (FIGURES 7A and 7B). Ankle range of motion is 15° dorsiflexion and 30° plantarflexion. She reports no ankle pain at all and has an unlimited tolerance for walking and standing. She can walk on uneven surfaces, including sand, with no problems. She has returned to horseback riding and moderate level skiing.

FIGURE 7A and 7B: One-year postoperative x-rays.

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Postoperative care is the responsibility of the medical professional.

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Surgical Pearls

- With this patient’s history of prior fracture, it was important to make a complete assessment of alignment with tibial x-rays.
- Using the PROPHECY® Preoperative Plan, adjustments to the cut guides were made during the planning stage to account for excessive bone and articular cartilage wear and ligament laxity.
- Solid seating of the components at the implant/bone interface was confirmed intraoperatively using fluoroscopy.
CASE STUDY: 2

INFINITY® Total Ankle Replacement System with
PROPHECY® Preoperative Navigation Guides in a
Patient with Varus Alignment and Degenerative
Ankle Arthritis

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Patient History

A healthy, active 70-year-old male with no clinical history of trauma or deformity presented with severe, limiting right ankle pain. The ankle pain pattern was deep central and medial pain. The patient walked with a limp favoring the right side and used a cane. He reported a 2-block walking tolerance and a 30-minute standing tolerance. Previous treatments included NSAIDs, ankle brace, and cushioned, rocker-soled shoes.

The patient had a history of gradual onset, progressive bilateral ankle pain. Five years prior to presentation, the patient underwent total ankle replacement of the left ankle with a HINTEGRA® implant and subtalar fusion. He reported to be happy with the left ankle although he was developing some osteolytic cysts.

Examination

On examination, the patient was observed to be a fit, 70-year-old male with a BMI of 26, who walked with a marked limp. The right hindfoot was in neutral alignment despite the planus deformity appearance of the midfoot and forefoot. The patient had tenderness at the anterior ankle and the medial gutter. The ankle range of motion was 5 degrees dorsiflexion and 30 degrees plantarflexion. There was pain and tenderness at the subtalar joint, with minimal range of motion.
Imaging and Diagnosis

AP and lateral standing ankle x-rays show end stage arthritis with medial talar shift and complete joint space loss in the medial gutter (FIGURE 1A and 1B). A full length, AP tibia x-ray shows 6 degrees of varus deformity of the tibial plafond with a congruent 6 degrees of talar varus with no tilt (FIGURE 2). CT scan shows advanced ankle arthritis and moderately advanced subtalar arthritis (COFAS Type 4), particularly involving the lateral process of the talus region (FIGURE 3).

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Imaging and Diagnosis...continued

The overall leg/ankle/foot alignment shows a “Z” deformity with a varus ankle and valgus hindfoot and associated, mild planovalgus foot. The talus shows the typical deformity associated with “Z” alignment, with the talar head lying significantly more medial relative to the talar body than normal. This can be observed on the Prophecy plan 3D images of the talus (FIGURE 4A and 4B).

FIGURE 4A and 4B:
Anterior and superior view of the talar PROPHECY® plan.
Case Assessment and Treatment Plan

The patient had severe right ankle pain and dysfunction that failed nonoperative treatment making surgical treatment of his right ankle arthritis appropriate. The patient’s age, BMI, activity goals, and ankle malalignment made him a candidate for either ankle arthrodesis or arthroplasty.

The patient had subtalar valgus malalignment along with pain and stiffness that was severe enough to warrant realignment and fusion. Tibiotalocalcaneal (TTC) fusion was also an option, but would leave his ankle very stiff. Two factors supported total ankle replacement as the favored option: the patient’s positive 5-year experience with his left ankle TAR, and diagnosis of COFAS Type 4 ankle arthritis with associated subtalar arthritis.

Based upon the above factors, PROPHECY® Preoperative Navigation Guides with INFINITY® Total Ankle Replacement System was selected to allow optimized implant positioning given the dysmorphic appearance of the talus and the distal tibia, particularly the medial malleolus.
Preoperative Planning

The tibial component was aligned to the tibial mechanical axis instead of the distal tibial anatomic axis, resulting in a correction of the varus plafond angle to neutral (FIGURE 5). Given the congruent varus ankle deformity, correction of the coronal alignment of the tibial joint line together with a neutral talar resection would result in correct realignment of the ankle (FIGURE 6).

FIGURE 5:
AP view of PROPHECY® preoperative planning. The blue line illustrates the mechanical axis and was used to set the coronal alignment for this case. The red line represents the patient’s distal tibial anatomic axis.

FIGURE 6:
Detail of PROPHECY® talar resection planning.

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Preoperative Planning...continued

In a varus ankle, significant ligamentous laxity is not expected and was not identified on clinical exam. For this reason, a standard tibial resection level was chosen, and the talus was minimally under-resected to avoid a risk of “over-stuffing” the joint. The medial talus will be pushed distally by 3mm or more due to the correction of the varus deformity (FIGURE 7). A medial release will likely be required. A subtalar fusion will be done in the same procedure.

FIGURE 7:
Preoperative Plan showing correction of the varus deformity. The talus shifts down on the medial side.
Surgery

The subtalar joint was debrided in preparation for fusion. A small lateral incision was made, and the sinus tarsi soft tissues were left untouched in order to avoid any disturbance to the talar blood supply. Only the posterior facet was debrided and prepared for fusion. Alignment and fixation of the subtalar joint was performed after the TAR was completed.

A standard anterior surgical approach was used for the ankle replacement. PROPHECY® guides were used for both tibial and talar cuts. Because of the subtalar fusion, care was taken to minimize stripping soft tissue from the dorsal aspect of the talar neck, taking only the minimum required to seat the PROPHECY® guide. The patient-specific PROPHECY® guides were seated, and the bone cuts were made.

Upon insertion of the implant (FIGURE 8), as expected, the medial side was tight. A medial release was required, and a vertical, sliding medial malleolar osteotomy was opted for. A reciprocating saw was used to make a vertical osteotomy just medial to the tibial component taking care to ensure that component position and fixation would not be affected.

Because of the dysmorphic medial malleolus with large medial prominence, a distally based wedge of bone (an inverted “V”) was resected from the osteotomy, allowing the medial malleolus to be narrowed. The osteotomy was then fixed with a screw and buttress plate (FIGURES 9A and 9B). Excellent stability and ligament balance was obtained with the osteotomy, and an 8mm polyethylene bearing was inserted.

With the ankle stable and realigned, the calcaneus could be held in the appropriate physiologic valgus position (5 degrees), and the subtalar joint was fixed with a single screw (FIGURE 9B).
Postoperative Care

The patient was placed in well-padded plaster splint before leaving the operating room. He remained splinted and non-weightbearing on the left leg for 2 weeks.

2 Weeks Postop

At 2 weeks postop, the sutures were removed, and a below-knee walker boot was applied. The patient was instructed to remain non-weightbearing due to the subtalar fusion. A physiotherapist in the clinic assessed the patient and provided instruction to the patient on gentle ankle range-of-motion exercises.

6 Weeks Postop

At 6 weeks postop, new standing x-rays were obtained. The patient was allowed to transition to full weight bearing in a walker boot. Physiotherapy was continued to work on ankle ROM.

12 Weeks Postop

At 12 weeks post-op, the patient was allowed to discontinue the walker boot. A more vigorous physiotherapy program was initiated. The patient was allowed to gradually return to full function with instruction to avoid activities that are at risk for falling, vigorous twisting, or repetitive impact. A plan was made for annual reassessment with x-rays.

1 Year Postop

At 1 year postop, the patient has no left ankle pain and has unlimited standing and walking tolerance. He reports that he is now playing five rounds of golf per week, walking all 18 holes. His ankle range of motion is 10 degrees dorsiflexion and 30 degrees plantarflexion (FIGURE 10A and 10B).

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Surgical Pearls

- This patient was diagnosed with COFAS Type 4 ankle arthritis with subtalar and/or talonavicular arthritis. Ankle replacement and subtalar fusion were done in one stage, with care being taken to ensure minimal disruption to the talar vascular supply. It is an excellent option for this patient, allowing ROM to be maintained while providing excellent pain relief.

- This patient had varus of the plafond angle, which required a medial release. This is common in total ankle replacement of a varus ankle, and a medial release with a sliding medial malleolar osteotomy was performed in conjunction with a subtalar fusion.
CASE STUDY: 3
INFINITY® Total Ankle Replacement System with
PROPHECY® Preoperative Navigation Guides in a
Patient with Valgus Alignment and Degenerative
Ankle Arthritis

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Patient History

A healthy, active 70-year-old male with no history of trauma or deformity presented with severe, limiting left ankle pain. The patient had a 15-year history of gradual onset, progressive bilateral ankle pain and elected to undergo arthroplasty of the right ankle 10 years prior. A STAR™ Total Ankle (STRYKER, Inc) was used, and following postoperative recovery, the patient resumed his high activity level, including hiking and sports. The patient underwent three additional surgeries of the right ankle to replace a fractured polyethylene component. Treatment for the left ankle pain included NSAIDs, an ankle brace, and cushioned, rocker-soled shoes.

Examination

On examination, the patient was observed to be a physically fit 70-year-old male with a BMI of 28. He reported pain localized to the anterior and lateral portions of his left ankle. The pain was worse with dorsiflexion and when walking on uneven surfaces. The patient was observed to walk with a limp favoring the left side. He reported a 6 block walking tolerance and a 1-2 hour standing tolerance.

The left hindfoot was in 10–15° valgus at the ankle level. The foot was neutral in appearance and alignment, with a stable deltoid ligament, and was not planovalgus. Tenderness on palpation was observed at the anterior ankle and the lateral gutter. The ankle had a range of motion of 10° dorsiflexion and 40° plantarflexion. The patient had full range of motion at the subtalar joint with no pain or tenderness.

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Imaging and Diagnosis

AP and lateral standing ankle x-rays (FIGURES 1A and 1B) show end stage arthritis with 15° valgus intra-articular talar tilt and no significant adjacent hindfoot arthritis (COFAS Type 2).

A left ankle SPECT-CT scan (FIGURE 2) shows advanced ankle arthritis with valgus tilt, lateral tibial plafond erosion, lateral gutter impingement, and no subtalar arthritis.

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**Case Assessment**

The patient had severe pain and dysfunction of the left ankle with failed nonoperative treatment, making surgical treatment of his left ankle arthritis well-warranted. The patient’s age, BMI, activity goals, and ankle alignment make him a candidate for either ankle arthrodesis or arthroplasty. Despite requiring three reoperations over the past 10 years to replace broken polyethylene inserts on his right STAR ankle replacement, the patient strongly favored total ankle replacement over fusion for his left ankle. He felt the preserved motion in his right ankle was extremely beneficial and wished to maintain his range of motion on the left as a result. In view of his experience with TAR, his well-preserved left ankle range of motion, and good bone stock, the patient elected to undergo total ankle arthroplasty with the INFINITY® Total Ankle Replacement System.

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Preoperative Planning

PROPHECY® Preoperative Planning was used to optimize implant position for correction of the significant 15° intra-articular valgus deformity. The tibial component was aligned to the distal tibial anatomic axis (red line shown in FIGURE 3); alignment to the mechanical axis would place the tibial component in 3.6° of valgus. In view of the preoperative valgus tilt, it is critical to avoid of any valgus positioning of the implants. The talar valgus tilt was primarily caused by ligament laxity and lateral tibial plafond erosion, but approximately 5° is due to lateral talar erosion. Therefore, the talar resection plane was set to correct 4.7° of valgus (FIGURE 4).

Because of good ankle ROM, substantial tibial and talar bone erosion, and the ligamentous laxity typically seen in valgus ankles, the ankle was expected to be “loose” if standard cutting guides were used. Therefore, preoperative planning included minimizing bone removal by “under-resecting” the talus by 3.7mm and the tibia by 1.5mm.

**FIGURE 3:** AP view of PROPHECY® preoperative planning. The red line illustrates the anatomic axis and was used to set the coronal alignment for this case. The blue line represents the patient’s tibial mechanical axis.

**FIGURE 4:** Detail of preoperative planning to correct valgus tilt with a 4.7° correction in talus resectioning.
Preoperative Planning...continued

The correction of the coronal alignment of the tibial joint line and the correction of the talar coronal joint line will result in correct realignment of the ankle, presuming appropriate ligament balance can be obtained (FIGURE 5).

The erosion of the talar dome resulted in a “flat-topped talus.” For this reason, an INBONE® II talar dome component was selected instead of an INFINITY® talar component. (FIGURE 6) illustrates the INBONE® II talar dome flat cut. (FIGURE 7) illustrates the INFINITY® talar component chamfer cut.

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FIGURE 5:
Preoperative plan showing the corrected talus location (blue) relative to the pre-op talus (gray) indicating valgus correction.

6

FIGURE 6:
Patient-specific PROPHECY® preoperative plan with INBONE® II Talar Dome.

7

FIGURE 7:
Patient-specific PROPHECY® preoperative plan with INFINITY® Talar Dome.

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Surgery

A standard anterior surgical approach was used. The PROPHECY® guides were used for the tibial and talar cuts. Excellent implant positioning and seating was confirmed with intraoperative fluoroscopy (FIGURE 8A and 8B). Excellent ligamentous balance was achieved without the need for additional ligament balancing procedures. A Baumann procedure for gastrocnemius lengthening was performed to gain maximal dorsiflexion of 15°.

FIGURE 8A and 8B:
Intraoperative AP and lateral view fluoroscopic images showing implant placement.
Postoperative Care

The patient was placed in a well-padded plaster splint in the operating room. The left leg remained splinted and non-weightbearing for two weeks.

2 Weeks Postop

At 2 weeks postop, the sutures were removed, and the patient was placed in a below-knee walker boot. A physiotherapist in the clinic assessed the patient and provided instruction on gentle range-of-motion exercises and weightbearing as tolerated in the walker boot.

6 Weeks Postop

At 6 weeks postop, new standing x-rays were obtained. The walker boot was discontinued, and a vigorous physiotherapy regime was initiated to include progressive return to normal function over the next six weeks.

12 Weeks Postop

At 12 weeks postop, the patient was allowed full return to normal function with instruction to avoid activities that risked falling, vigorous twisting, or repetitive impact. A plan was made for annual reassessment with x-rays.

2 Years Postop

The patient is now at 2 years postop (FIGURE 9A and 9B). He reports no left ankle pain and has unlimited standing and walking tolerance. He has returned to hiking and low intensity tennis, and can walk on uneven surfaces with no problem. Ankle range of motion is 15° dorsiflexion and 40° plantarflexion.

FIGURE 9A and 9B: 2-year postoperative AP and lateral view x-rays.
Surgical Pearls

- Because this patient had ankle arthritis with valgus deformity, it was important to rule out deltoid ligament insufficiency prior to considering TAR. This is done with a careful clinical exam, feeling for a solid endpoint in valgus tilt.

- This patient had a ligament laxity, which is typical in valgus ankles.

- This patient had a “flat-top” talus resulting from arthritic changes, therefore a talar component that utilizes a single flat cut was used to better match this patient’s talar bone geometry.