Integra®
Salto Talaris® XT Primary and Revision Total Ankle Prosthesis
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J. Chris Coetzee, MD is a world renowned surgeon who has been asked to lecture and teach in more than 20 countries around the world. His orthopedic expertise is in foot and ankle reconstruction, trauma injuries and sports medicine.

Dr. Coetzee earned his medical degree from the University of Pretoria School of Medicine in South Africa and completed his residency at the University of Stellenbosch. He achieved a trauma fellowship in Davos, Switzerland and a foot and ankle fellowship at the University of Washington and the Harborview Medical Center, in Seattle, WA. He is a published author in numerous peer-reviewed journals.

Dr. Coetzee sees patients at Minnesota Orthopedic Sports Medicine Institute in Edina, MN. He serves as a fellowship faculty member for the MOSMI/ Fairview Orthopedic Sports Medicine Fellowship program. He is also an active member of the AOFAS and has held several prestigious positions within the organization.

Mark S. Myerson, MD is world renowned as a leader in advancing foot and ankle reconstruction treatment. Dr. Myerson has worked throughout his career to find new and innovative techniques for foot and ankle surgery. His research in foot and ankle orthopedics has led to the development of treatment styles that have become the standard of care for many hospitals.

Dr. Myerson earned his medical degree from the University of Cape Town in South Africa, completed his residency in Baltimore, MD and is past President of the American Orthopedic Foot and Ankle Society. He has authored five textbooks in the field of foot and ankle reconstruction, and has published over 300 manuscripts in numerous professional and medical journals. He is a frequently invited guest speaker, giving professional talks around the globe as consultant and educator. He travels frequently around the world on humanitarian programs for underprivileged and disabled citizens with deformities, simultaneously teaching and enabling surgeons in those countries to continue care of these patients.

In 2002, Dr. Myerson founded The Institute for Foot and Ankle Reconstruction at Mercy Medical Center in Baltimore, where as Medical Director, he leads a team of expert, fellowship trained foot and ankle surgeons. The institute is also home to a prestigious International Fellowship program.
Case Study 1

**INFINTY® Total Ankle System revision to Salto Talaris XT Primary and Revision Total Ankle Prosthesis**

**Past Medical History/Pre-Operative Diagnosis/Planning**

AT is a 55-year-old female. She suffers from stage 4 renal disease, diabetes insipidus, hypothyroidism, rheumatoid arthritis with rheumatoid factor, and a history of DVT. Her BMI is 26.59.

When she was 50, she presented to our clinic in 2011 with symptomatic pantalar arthritic involvement of her left foot, secondary to her rheumatoid arthritis. She had tried and failed bracing and other non-surgical care. Her care was being previously managed by the rheumatology team at our institution. Her x-rays and her foot exam indicated that her foot arthrosis was more symptomatic than her ankle arthrosis at that time. (Figure 1) We elected to proceed with a hindfoot fusion and midfoot fusion to deal with her current, painful situation. In February of 2014, she underwent a left foot triple arthrodesis, a midfoot fusion, including the navicular cuneiforms and the tarsal metatarsal joints with a gastroc recession. She developed a nonunion of the talonavicular portions and the second and third tarsal metatarsal portions of that fusion and underwent a revision arthrodesis of that in November 2012 (Figure 2).

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Figure 1a: AP foot radiograph showing widespread arthritic change across the midtarsus.

Figure 1b: AP ankle radiograph showing mild narrowing of the ankle joint indicative of early arthritis.

Figure 2a: AP foot radiograph after midfoot arthrodesis.

Figure 2b: Lateral foot radiograph after midfoot arthrodesis.

Figure 1c: Lateral view of ankle and foot showing diffuse arthritic change of the ankle and midtarsus.
She did well for several years. Her foot was functioning well and had a lot less pain. However, her ankle deteriorated over the next three years and became very painful and symptomatic for her. She again tried and failed non-surgical care including bracing, anti-inflammatories, and injection therapy. In 2015, her x-rays at this point showed a mildly incongruent ankle with bone on bone arthritis in mild valgus (Figure 3a, b). She underwent a total ankle replacement in November of 2015 using the Wright Medical Infinity Prophecy System. She underwent a tendo-achilles lengthening for recurrent contraction of her calf muscle as well (Figure 4a, b). She never did well following that surgery. She always complained of pain despite initial post-operative care, non-weight bearing for six weeks and then rehabilitation. X-rays eleven months from surgery showed aseptic loosening of her implant both on the tibia and talar side (Figure 5a, b). While her inflammatory markers were elevated, likely due to her rheumatology condition, pre-operative aspiration of the ankle was negative for bacterial growth.

Preoperatively, in October of 2016, she had no deformity at this time. She had a well-healed hind-foot fusion. She had aseptically loose total ankle that was radiographically in good position. The decision was to revise the ankle with the Salto XT system.

**Intra-operative:**

On October 31st, 2016, she was taken to the operating room for the revision surgery. The approach was the same incision as used previously, an anterior approach which was 12cm long in midline. There was no real normal anatomy from several previous surgeries. Dissection was carefully carried down to bone and then a full thickness flap of skin, subcutaneous tissue scar, was elevated off the ankle to expose it. The Wright Medical Infinity ankle was grossly loose and came out uneventfully. We used simple curved osteotomes to shoe-horn out the implants and remove them with bone forceps. There was no gross evidence of any...
bony ingrowth on the implant (Figure 6). The previous cuts were straight and it was deemed only necessary to freshen up the cuts minimally. The Salto Talaris cutting guides were placed on to the ankle such that only several millimeters of additional bone were removed (Figure 7a, b). Once the bone cuts were made, the scar tissue was removed and the gutters were re-debrided. The trials were then placed into the body and secured to bone with k-wires (Figure 8a, b). The talus was prepared with the appropriate mills. Once the talus was prepared, the tibial trial was placed and the keel drilled. Due to ligament elasticity, the largest polyethylene insert was placed, a 17mm poly. X-rays were taken and confirmed and then we closed the wound in layers (Figure 9a, b).

**Post-Operative:**

Post operatively, AT will be non-weight bearing for a minimum of six weeks and will be formally casted to maximize immobilization and to allow the bone metal interface to heal. At that time, we will begin weight bearing her in a boot and start therapy for six to eight weeks and then ween her to a shoe. The ankle radiographs at 3 months post-operative show good early success of implant (Figure 10a, b).
Case Study 2

Fusion Takedown to Salto Talaris® XT Primary and Revision Total Ankle Prosthesis

Past Medical History:

A female patient was involved in a serious MVA in 1990 and sustained multiple injuries including a left Pilon fracture. An ORIF was done of her ankle as well as an acetabulum fracture.

Over time the patient developed severe DJD of both her ankle and hip. Due to increasing symptoms, an arthroscopic right ankle fusion was done in September 1999 at age 47. This was followed by a right hip replacement in 2001.

After 10 years, the patient developed progressive subtalar and talo-navicular pain. Sequential injections gave her good pain relief, but she was looking for options to protect those joints, and not face a pantalar fusion.
Surgical Technique:

A standard 15 cm midline anterior approach between the Tibialis Anterior and Extensor Hallucis Longus was used to expose the joint. Due to the arthroscopic fusion in the past, the gutters were open – not fused – which made planning the ankle cuts fairly simple. Had the gutters been fused the necessary debridement would have been more extensive.

A lateral fluoroscopy view was used to confirm the joint level, which was then marked over the anterior aspect of the joint. The standard external tibial guide was used to make the tibial cut 8 mm from the marked joint level. Once the first tibial cut is made care was taken to ensure the gutters as clear and free. As mentioned, with the arthroscopic technique the gutters were open in this case, but in some fusions a reciprocating saw will be needed to open the gutters.

The XT cutting blocks provide the surgeon with an easy-to-use template to cut the talus to minimize bone loss.

Tips and Pearls:

After a previous fusion it is rare that the ankle will be unstable. In fact, most ankle will have a stiff soft tissue envelope. It is best to plan “sufficient” bone cuts, and not undercut and overstuff the joint.

If the fusion was done with flat cuts there may be an element of bone loss. In that situation there is a case to make to distract the ankle once the tibial cut is done and the gutters cleaned. A lamina spreader can be placed in the joint to distract it 4-5 mm to minimize the talar cut or the level of cut can be adjusted through the tibial Alignment guide.
Case Study 3

Primary TAA to Salto Talaris® XT Primary and Revision Total Ankle Prosthesis

Past Medical History:

A 55 year old male suffered a fracture dislocation of the talus after a motorbike accident 20 years earlier. He tried to postpone definitive treatment as long as possible. Prior to the Salto Talaris XT, the only option he was given was a fusion. Due his work as a geologist, he wanted to preserve motion as much as possible.

Surgical Technique:

In this case the tibia was normal, while at least 30% of the body of the talus was avascular. This is not a case one can solve with a primary surface replacement. The plan was to use a standard midline anterior approach between the Tibialis Anterior and Extensor Hallucis Longus tendon.

It was obvious that more of the talus than usual would be removed to include all the avascular bone. The distal tibial cut removed only 6 mm of bone. (It is easy to remove more if needed.) With the Salto Talaris XT flat cut talus all the avascular talus was removed.
The final components fit perfectly on the prepared surfaces.

**Tips and Pearls:**

In a situation like this the tibial cut could be as little as 5 mm to accommodate for the larger talar cut needed to remove all the avascular bone. It is fairly easy to increase the tibial cut if more space is needed.

It is imperative to do the talar cut under fluoroscopy to ensure the alignment of the cut. One has to stay a fair distance from the subtalar joint. Utilizing the talar cut guide it is possible to align the talar cut level with desired resection of the talus before the tibial cut. The amount of space allowed by the cutting jig between the talar cut and tibial cut is enough space for the talar component and a 8 mm tibial/poly construct.

It is often necessary to do a generous talonavicular cheilectomy to allow placement of the talar cutting guide.
Case Study 4

Agility™ LP Total Ankle Replacement to Salto Talaris® XT Primary and Revision Total Ankle Prosthesis

Past Medical History:

This patient is a 55 year old female who has undergone a prior Agility replacement. Note the subsidence of the talar component with bone build-up circumferentially around the joint. There is no range of motion of the ankle at all as a result of the subsidence and bone over growth of the agility prosthesis.

Note that the ankle joint is not visible with dissection to the joint. The entire anterior joint has been obliterated with bone and scar.

In order to visualize the joint, debridement is performed with a large rongeur. Care must be taken to visualize and protect the neurovascular bundle which is typically encased in scar.
With gradual debridement the prosthesis becomes visible.

An osteotome is inserted to lever the polyethylene component out from the tibial component. Depending on the type of Agility prosthesis, the poly may have to be cut out in pieces since it can be very difficult to remove the polyethylene which loads vertically. The polyethylene from the last generation of the Agility LP prosthesis is easier to retrieve since it can be wedged out anteriorly, unlike the earlier versions of the Agility which had fins on the polyethylene which require removal by levering vertically on the poly since it will not slide out anteriorly. In the older version of the Agility it is not possible to remove the poly until the talar component has been removed.

With the poly removed, the talar component is now removed. Since the talar component is likely to be loose, a fine 6 mm osteotome is inserted under the talar component to loosen it up further. It is useful to insert the threaded guide from the Agility replacement into the talar component to help facilitate its removal.

The talar component is now removed.
It is imperative that as much anterior tibial cortex is preserved as possible to support the revision component. This is not always possible if there is solid bone ingrowth, in which case a fine osteotome is inserted under the tibial component to loosen it further and pry it loose without creating a defect in the anterior tibial cortical rim. The Agility tibial component has a fin which is on the medial side of the prosthesis and is generally buried beneath 6-8 mm of anterior bone hiding the position of the fin. It is ideal to preserve this anterior rim of bone which increases the anterior cortical rim for support of the revision prosthesis. It is generally possible to do so by using an osteotome under the visible portion of the tibial component and gradually loosening it. Once the tibial component is loose then a tamp should be used to push the component. This way the majority of the anterior cortical rim is preserved.

It is helpful to be able to remove the tibial component with the threaded inserter tool from the Agility set.

Debridement of the medial and lateral gutters is now performed with a reciprocating saw. All heterotopic bone must be removed so that there is smooth unimpeded range of motion of the ankle. There should be about 4 mm of space in each gutter following this debridement with the saw. Care must be taken on the medial gutter not to cut into the apex of the medial joint which will weaken the medial malleolus. It is helpful to use provisional k-wires in the medial malleolus to prevent fracture.

In this case, free hand cuts were made on the tibia to prepare for the tibial component. It is important to insert the tibial trial component and check the position fluoroscopically to ensure that it is centered and not lifting off either anterior or posteriorly.
The talar and tibial trial components are inserted together with the appropriate sized polyethylene and the ankle range of motion evaluated. It is important to ensure that the talar component is centered correctly over the body of the talus. The tibia will follow the talus and must be centered in the tibia.

The anterior talar positioning pins are inserted after pre-drilling. Before inserting these pins the position of both components must be checked fluoroscopically. There is a tendency for the trial components to shift with range of motion of the ankle, and the foot should be kept in maximum dorsiflexion to lock the components in place, check the position under fluoro, and then maintain this position before drilling and insertion of the anterior talar pins. Once the talar positioning pins are inserted the ankle must be checked again under fluoroscopy before making the tibial drill holes.

The tibial drill holes are made while the talar component trial is locked in position with the talar setting pins and the foot held in dorsiflexion to compress and maintain the correct position of the tibial component. Once drilled, reamed and drilled a small rongeur is used to remove bone between the two drill holes prior to using the rasp on the tibia.

It is far easier to drill the talus for the talar stem (left) and the posterior slotted holes (right) once the tibial trial component is removed. This is done with the foot in maximum plantarflexion otherwise the anterior tibial cortex is in the way and blocks the reamer.
At the completion of the bone preparation, make sure that there is no debris in the gutters, that the gutters are completely decompressed and that there is no scar tissue remaining in the posterior capsule which will block range of motion.

Following insertion of the components, check the range of motion and perform a percutaneous lengthening of the Achilles if 10 degrees of dorsiflexion has not been achieved.

The immediate postoperative XR. Note the clearance of bone in the gutter. The tibial component is slightly extended relative to the axis of the tibia in order to gain slightly more dorsiflexion of the ankle.
Case Study 5

STAR™ Total Ankle Replacement to Salto Talaris® XT Primary and Revision Total Ankle Prosthesis

Past Medical History:

This patient is a 52 year old male who underwent a STAR ankle replacement 9 months ago. He presents with pain circumferentially around the joint. Both the tibial and talar components were noted to be loose with a dislocation of the poly. There was no evidence of infection.

The patient had both ankle and subtalar joint pain and the plan was to revise the ankle and fuse the subtalar joint simultaneously.

Note preservation of motion on flexion and extension lateral x-ray of the foot.
The malalignment and loosening of the components is noted.

CT scan evaluation of the ankle and hindfoot is very important to plan a revision ankle replacement. Note the subtalar arthritis, the valgus of the heel, the subluxation of the components and the cyst formation in the body of the talus.

Note the dislocation of the polyethylene.

The talar component was completely loose and easily came out. One has to be careful with removal of the tibial component since the barrels of the component may cause additional bone loss with removal. In this case, a thin osteotome was inserted under the tibia and the component easily removed. If there is bone loss with removal of the tibial component then one could cement the tibial component as an alternative to cancellous bone grafting.
This is one technique which can be used to set the position of the tibial component when it is felt preferable to commence with the tibia. While this is an option, it is not ideal since the tibia generally should “match” the orientation of the talus. In some revision cases however, it is sometimes difficult to position the talus correctly due to bone loss, and in these cases, begin with the insertion of the tibial component. The trial tibial guide is set in position with a laminar spreader and the position checked under fluoroscopy. It was recognized however that this was not ideal because the talar component was too far medial with the tibial component set in this position. For this reason, the tibia and talar trial components were inserted simultaneously.

The assembly of the components

It is preferable to insert all three components simultaneously. Start with the smallest poly and determine if the joint is stable. If one is not certain about the size of the poly to use initially, then a ruler can be used to measure the space of the ankle and the prosthesis prior to inserting the trial components.

Note that the position of the tibial component is not ideal.

The tibial component is slightly lateral and follows the position of the talar component. For this reason, the talus must be pushed more medially before inserting the talar positioning pins. There is plenty room medially under the tibia to support the prosthesis. The talar component was pushed more medially getting a better alignment of the tibial component.

Note the use of provisional pin fixation of the medial malleolus. This is a good precaution to take on all revision replacements.
Note the final position of the foot and ankle.

When performing a subtalar arthrodesis simultaneously, it is important to debride only the posterior facet with a very limited incision under the fibula. This minimal approach is sufficient for exposure and there is less stripping and devascularization of the joint as occurs if a complete sinus tarsi exposure is performed.
Case Study 6

Salto Talaris® Total Ankle Prosthesis to Salto Talaris® XT Primary and Revision Total Ankle Prosthesis

Past Medical History:

These are the preoperative radiographs of a 77 year old female who underwent a previous ankle replacement. The details of her prior surgery are not known. She presented two years following the primary procedure with constant pain, in particular with initiation of activities as well as aching, throbbing and swelling of the ankle.

The original incision used for the replacement was incorrect. It is far too medial and following this incision again creates a greater risk for wound healing issues because of excessive retraction than making a curved incision down the center of the ankle and foot which was done.
The contact between the components was noted to be incongruent and this was probably the reason why both were loose. Note the poor contact between the talar component and the polyethylene. The tibial component was quite loose and an erosion of the bone around the stem was noted. Upon probing it was apparent that the talar component was also loose.

The tibial component must be very carefully levered downwards without crushing any more bone of the distal tibia. In this case since the component was loose and there was already an erosion around the stem, this step was far easier.

In a case like this where the bone support is generally good and minimal deformity, collapse or erosion is present, it is not necessary to use the external alignment guides. However, it is important to correctly size the components. Note the use of the tibial trial which is used for a sizer. There should be about 5 degrees of rotation of the component possible in each direction, but with a snug fit. The sizer is applied to the talus and there should be no more than 1-2 mm of bone medially and laterally for a good fit. In this case the tibial component size remained the same and the talar component was downsized to better match the talar body.
The surface of the talus was quite irregular and had to be trimmed with a saw. There was slight lateral erosion and it appeared that the talus had been slightly eccentrically cut in the primary procedure. A saw was used to free-hand cut the talus removing only 1-2 mm of bone on the medial surface of the body.

The trial components were inserted together with the polyethylene spacer. There is slight medial overhang of the talar component which although acceptable is not ideal, and both components can easily be pushed laterally using the medial joint retractor.

Following joint preparation, the trial components are inserted simultaneously once the correct polyethylene size was selected. Note on image A that the talus has been inserted too far back posteriorly. The center of the talar component must line up with the center of the lateral process of the talus. The position of the components was adjusted by translating them anteriorly and the corrected position is noted on image B.
On the AP ankle view, the tibial component follows the talus and in this case appears to have been very slightly translated laterally. Since the talar component is well centered over the talar body, the tibia is in the correct position, and one must not try to push the tibial component medially in order to reposition it over the original tibial slot. This will mean that there is unlikely to be a good press fit of the tibial component upon insertion, and one has to anticipate the use of either cancellous bone graft or cement. In this case despite the defect noted, there was marked stability of the tibial component present, and the defect was filled with a mixture of compacted allograft cancellous bone chips and DBM.

The tibial reaming and drilling must be done while the talar component is held in place securely with the talar positioning pins.

The tibial trial is removed and the talar reaming and drilling is performed. It is far easier to do this step with the tibial component out of the way, since even with plantar flexion of the foot, it is difficult to ream the talus with the tibial component in position.

The talar component has been impacted and the tibial component well seated. It was surprisingly quite stable, hence the use of cancellous graft and DBM fill the slight void.
Once the prosthesis has been inserted and stability achieved with cement, the subtalar arthrodesis is performed. It is essential to use a minimal approach to the subtalar joint with a small incision under the fibula which is located over the posterior facet. Only the posterior facet is debrided, minimizing the risk of devascularization of the talus with debridement of the sinus tarsi. It is easier to insert the screws from the neck of the talus down into the calcaneus, but important to ensure that the screws are not in any way making contact with the talar component. If the screw abuts the talar component when inserted, it will loosen up the component by lifting it off the talar body.

The postoperative radiographs demonstrate a well aligned stable prosthesis with a solid subtalar arthrodesis.
Case Study 7

Primary TAA to Salto Talaris® XT Primary and Revision Total Ankle Prosthesis

Past Medical History:

These are the preoperative radiographs of a 72 year old female who presented with severe hindfoot pain and rigid flatfoot deformity. Mild ankle pain was present at this time with slight valgus tilt of the ankle joint noted.

Note the satisfactory alignment following the triple arthrodesis. There is already increased valgus tilt to the ankle with advancing arthritis already present.
Three years following the triple arthrodesis the foot is collapsed despite a satisfactory arthrodesis. The recurrent valgus deformity is a result of a marked and fixed valgus tilt of the ankle joint.

It is important to understand the relationship of the rigid flatfoot deformity following this triple arthrodesis and the fixed valgus deformity of the ankle joint. Invariably when the cut on the talus is made, it is done with the talus in the corrected position so as to ensure that the ankle is in a neutral alignment with respect to the leg and the foot. However, to correct a fixed valgus deformity assumes that the foot will be simultaneously plantigrade which cannot take place following a triple arthrodesis. One could cut the talus perpendicular to its axis but with the hindfoot fused, it would force the ankle back into a valgus position. Another option would be to place the talar component in the correct position and revise the triple arthrodesis. Here however a decision was made to leave the foot in what had been the corrected position and cut the talus obliquely.

The hindfoot is reduced to a neutral position and held while noting the abnormal alignment of the talus. The talus is then cut obliquely using the talar cutting guide. Note the angle of the cut on the talus with the foot held in the neutral position.
Once the correct position of the trial components is verified, the talar positioning pins are inserted as noted here. Following this step, the tibia must be drilled and reamed for insertion of the tibial component, before the talus is prepared. The tibial trial component is removed and the talus drilled and reamed in preparation for insertion of the talar component. It is far more stable and more predictable to drill the talus once the tibial trial component has been removed.

The final intraoperative images including extension and flexion lateral views of the ankle.

The immediate post operative radiographs are noted including the flexion and extension lateral view of the foot. Note the addition of an arthrodesis of the 1st tarsometatarsal joint which was needed to plantarflex the medial column and maintain a plantigrade forefoot.
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