Salto-Talaris Total Ankle Arthroplasty: Features, Surgical Technique, and Results

SALTO-TALARIS TOTAL ANKLE ARTHROPLASTY

Total ankle arthroplasty (TAA) has become a topic of increasing interest over the past decade as patients and orthopedic surgeons demand a better alternative to arthrodesis. During the 1970s and 1980s, TAA had a reputation for a high failure rate, and as a result, arthrodesis was the preferred method of treatment for tibiotalar arthritis. More recently, however, improved surgical technique, improved surgeon experience, and improved design of surgical instrumentation and implants have led to superior outcomes compared to earlier TAA generations.

PATHOGENESIS OF ANKLE OSTEARTHritis

Degenerative, posttraumatic, and inflammatory arthritis are the primary causes for tibiotalar degeneration. Other causes are observed relatively infrequently but include pigmented villonodular synovitis, hemochromatosis, and osteochondral lesions of the talus.

FEATURES OF SALTO-TALARIS

The Salto-Talaris (Tornier, Bloomington, MN) TAA is an anatomically designed, fixed-bearing prosthesis available in the United States—approved by the Food and Drug Administration (FDA) in November 2006. This design is based on a mobile-bearing design (Salto) that has been used outside of the United States.

The initial three-piece “Salto” design (Fig. 4.1) displayed good early results, but a study using postoperative radiographic evaluation to assess polyethylene motion demonstrated little to no motion of the mobile bearing. This lack of motion led to the fixed-bearing design of the Salto-Talaris (Fig. 4.2).

A key feature of this fixed-bearing implant is that the mobile-bearing concept has been incorporated into the trial reduction stage. During the trial reduction, the mobile tibial trial component is allowed to rotate into proper position during ankle range of motion. It is thought that with repetitive plantar flexion and dorsiflexion, the tibial component will settle into the most appropriate anatomic axis of the ankle.

Figure 4.1. Salto mobile-bearing design.

PRINCIPLES AND GOALS OF TAA

The goals in performing TAA are pain reduction with restoration of the mechanical axis of the affected ankle, restoration of the anatomic joint line, and restoration or maintenance of soft tissue balance. These basic principles should be achieved in the operating room in order to optimize patient outcomes.

TECHNIQUE

Positioning

The patient is placed in a supine position with the patella of the affected extremity facing the ceiling. If needed, a bolster is placed under the ipsilateral hip to help achieve neutral rotational alignment of the lower extremity. Ensure that the plantar aspect of the foot is placed at the most distal edge of
the operating table as the surgeon will operate from the foot of the bed. A thigh tourniquet is placed prior to sterile draping. Patient preparation and sterile draping should include the knee joint. The fluoroscopy machine will be set up on the operative side of the operating room table.

**Approach**

A standard anterior midline incision is used to gain access to the tibiotalar joint. The incision is placed one fingerbreadth lateral to the anterior tibial spine and is started 6 to 8 cm proximal to the ankle joint and continued approximately 4 to 5 cm distal to the ankle joint (Fig. 4.3).

Sharp dissection is carried through the skin and subcutaneous tissue. Care is taken not to undermine the skin edges. Manipulation of the skin edges is also kept at a minimum. If necessary, the skin incision is extended to take the tension off the wound during retraction. Retraction is not performed until the extensor hallucis longus (EHL) is taken out of its sheath. The superficial peroneal nerve is identified and marked with a marking pen (Fig. 4.4), and this is protected throughout the entire procedure.

Meticulous hemostasis is maintained during the approach. The extensor retinaculum is then identified. The interval for this approach is between the EHL and tibialis anterior (TA) tendons (Fig. 4.5). After identifying the EHL and TA tendons, an incision is made over the EHL sheath.

The TA is kept within its sheath to prevent any bowstringing postoperatively. This approach also protects the tendon during closure of the anterior incision. Next, the neurovascular bundle is found and retracted laterally. Gelpi retractors are used to retract medial and lateral deep soft tissues. The periosteum and joint capsule are sharply incised in line with the incision. Medial and lateral flaps are created with a scalpel and a periosteal elevator. The operating surgeon’s goal is to see both the medial and lateral gutters clearly. Elevation of the joint capsule is taken just proximal to the talonavicular joint. Exposure of the articular surfaces of the talonavicular joint is avoided.

Using an osteotome and a rongeur, anterior tibial and talar osteophytes are removed. In addition to the removal of the anterior osteophytes, approximately 5 mm of the anterior distal tibia is removed. A reciprocating saw is started in the medial and lateral gutters, respectively. The saw is brought proximally through the distal aspect of the tibia. An osteotome is then used to remove the distal anterior lip of the tibia. This will allow visualization of the apex of the tibial plafond. A ¼-in osteotome

**Figure 4.2.** Salto-Talaris fixed-bearing design.

**Figure 4.3.** Anterior ankle incision.

**Figure 4.4.** Marking of superficial peroneal nerve.
is placed in the medial gutter to help determine the rotation of the ankle.

**Tibial Resection**

The goal is to restore the mechanical axis in the coronal plane and match the posterior slope in the sagittal plane. The extramedullary guide is aligned parallel with the anterior tibial crest in the coronal plane (Fig. 4.6A) and in the sagittal plane (Fig. 4.6B).

The extramedullary guide is secured proximally with a self-drilling pin. This pin should be perpendicular to the anterior tibial crest, with about 5° of external rotation.

Using the extramedullary guide and fluoroscopy, the coronal plane orientation is assessed. In a tibia without deformity, the goal is to make a perpendicular cut to the mechanical axis of the tibia. If the coronal plane alignment is slightly deviated, it can be easily corrected by shifting the extramedullary guide medially or laterally by sliding it over the proximally placed tibial pin. If there is a severe deformity proximal to the ankle, then this should be corrected prior to the TAA, either simultaneously or with a staged procedure.

The next assessment will be the sagittal plane orientation. The purpose of the extramedullary alignment guide is to reproduce a maximum 7° posterior slope of the distal tibia. The guide needs to be parallel to the anterior tibial crest for this to be reproduced.

After achieving satisfactory coronal and sagittal plane orientation, rotational alignment is evaluated. Rotation is critical for correct implantation of the TAA. Malrotation could lead to malleolar impingement or edge loading of the polyethylene. The goal is to place the implant on the center bisecting line of the talus in the coronal plane (Fig. 4.7). A ¼-in osteotome is placed into the medial and lateral gutters. A short guide pin is placed into the rotational jig. The goal is to align the pin in the center of the “goal post” created by the osteotomes. Some have advocated using the second metatarsal for rotational alignment; however, we find that a midfoot or forefoot deformity can misguide the rotation.

The resection level should aim to restore the anatomic joint line of the ankle. The amount of distal tibial resection should match the combined thickness of the metal and polyethylene components. The reference point is the apex of the tibial plateau as described in the approach. Bone loss in the tibia may require intraoperative adjustment to establish the proper level of the joint line.

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**Figure 4.5.** Interval between EHL and TA.

**Figure 4.6.** Fluoroscopic imaging. Setting coronal alignment (A) and sagittal alignment (B).
lateral drill holes are connected with a reciprocating saw. The anterior \( \frac{3}{4} \) to \( \frac{1}{2} \) of the distal tibia piece can now be removed. This is performed by placing a \( \frac{3}{8} \)-in curved osteotome into the ankle and carefully cutting from the articular cartilage into the bone cut. The anterior \( \frac{1}{2} \) to \( \frac{3}{4} \) of the tibia piece is then removed. Rarely can this be removed in one piece. The remaining posterior distal tibia can then be removed in a piecemeal fashion after completing the posterior talar cut.

**Talar Preparation**

The talar preparation consists of three cuts. The extramedullary tibial alignment guide is left in place and the talar pin guide is attached. To be able to perform the talar cuts, the talus must be dorsiflexed to \( 5^\circ \). If the ankle cannot be dorsiflexed to this position, then an Achilles tendon lengthening or a gastrocnemius–soleus recession can be performed. Usually, we wait to perform this once the trial components are placed.

When placing the talar guide on the extramedullary tibial alignment guide, the ankle must be maintained in \( 5^\circ \) of planatar flexion, physiologic valgus, and neutral rotation (Fig. 4.9). There are three holes in the sagittal plane of this guide.

Using fluoroscopy determines the correct drill hole; this should result in a reference pin placed at the base of the talar neck/body junction. Too much dorsiflexion will cause an anterior and flexed position of the talar component and excessive plantar flexion will cause a posterior tilt to the talar component. The extramedullary guide is then removed.

After being satisfied with the placement of the talar pin, the surgeon should attach the paddle guide to the construct. A laminar spreader is placed over the paddles as posterior as possible. Once the laminar spreader is placed medially, and the other laterally, equal distraction is placed over both spreaders. Next, a drill hole is placed in the most medial hole, followed by a pin. Another drill hole is then placed in the most lateral hole, followed by a pin. A lateral fluoroscopic x-ray of the ankle is then obtained to assess the level of the talar cut and the angle of the guide (Fig. 4.10). Once satisfied with the position, the final two holes are drilled and pinned (Fig. 4.11).

Ribbon retractors are then placed into the medial and lateral gutters to protect the respective malleoli. The talar cut is
rongeur is used to remove osteophytes from the talar neck so that the talar guide is properly seated, and can be moved posteriorly. Rotation should be set using the second metatarsal as a guide—unless there is a midfoot deformity (Fig. 4.13).

The anterior chamfer guide is then secured with two pins. If further stabilization is needed for the guide, laminar spreaders can be placed to hold the jig in place. The reaming guide is attached and the anterior chamfer cut is made using a milling device (Fig. 4.14). This guide is then removed and any bone on the medial and lateral aspects of the talar neck that was not milled away is removed with a rongeur.

The lateral chamfer cut and the talar stem preparation will be the next steps in the surgery. The guide is placed with the lateral “t” placed flush with the lateral talar cortical body. The handle of the guide is aligned with the second metatarsal. If needed, this guide can be cheated 2 to 3 mm medially. Using the lateral chamfer guide, a talar stem recession is performed using a bell saw (Fig. 4.15). Advance the bell saw until there the hard stop abuts the guide.

This will set the proper depth for the talar plug. A metal peg is then inserted into the guide to provide greater stability.
A ribbon retractor is placed in a lateral gutter and the lateral chamfer cut is made using a reciprocating saw (Fig. 4.16).

**Insertion of Components**

The trial talar component is inserted. There should be adequate coverage in the mediolateral dimension—avoiding medial overhang. This may appear loose because it lacks the plasma coating that the “actual” implant has, thus no press fit will be obtained with the trial component. Next, insert the trial tibial base and a trial polyethylene. The joint is reduced. The ankle is ranged from flexion to extension allowing the tibial assembly to freely rotate and find its ideal position. If the ankle cannot be brought into 10° of dorsiflexion, a triple hemisection Achilles lengthening or gastroc–soleus recession is performed. The ankle is carefully brought into dorsiflexion to avoid fracturing of the malleoli. The ankle is then ranged a number of times throughout its entire arc of motion.

A lateral fluoroscopic image is taken to confirm whether the tibial plate is flush with the distal tibia prior to drilling for the tibial keel. Once satisfied with the final position of the tibial component, holes are drilled in the tibial assembly. The most distal hole is drilled and pinned. The proximal hole just above that is then drilled (Fig. 4.17). Finally, the large cylindrical drill hole is bored to the positive stop.

The tibial trial is removed. These holes are then connected using a reciprocating saw. Care is taken to round off the edges of the keel cuts. A box osteotome is then malleted in to the level of the size of the tibia (Fig. 4.18). The trial tibia is then inserted. Different trial polys are then placed to determine the size of the poly that allows for stabilization of the ankle.

The wound is thoroughly irrigated and the final components are placed. First the talus is placed and impacted. Next the tibia

**Figure 4.14.** Anterior chamfer cut performed using milling device.

**Figure 4.15.** Talar stem recession.

**Figure 4.16.** Lateral chamfer cut.

**Figure 4.17.** Drilling of the tibial trial.

**Figure 4.18.** Bone cuts after tibial trial removed.
and poly are placed. Once the tibia passes the curvature of the talus, a caudal force is placed on the heel to ensure that the tibia component remains flush on the tibial cut (Fig. 4.19).

Stability and range of motion are tested. Autograft is inserted in the tibial window (Fig. 4.20) to prevent joint fluid from entering and causing large cysts that could influence component fixation.

A reciprocating saw is then used to debride any overhanging medial talar bone. This helps prevent the possibility of impingement. Final fluoroscopic images are obtained in coronal and sagittal planes (Fig. 4.21).

**Wound Closure**

Closure of the skin must be done with meticulous surgical technique. The wound is first irrigated thoroughly. The joint capsule is closed with 0-vicryl suture, and the tendon sheath with 0-vicryl suture. The extensor retinaculum and subcutaneous tissues are closed with 2-0 vicryl suture. The skin will then be closed with nonabsorbable mattress-type sutures or staples.

**Postoperative Protocol**

A technique that we have started to utilize is using the PICO incisional VAC for assistance in wound closure. We have noticed decreased wound slough and dehiscence using this closure technique, especially at the anterior ankle crease. After placement of the VAC device, the patient is placed in a bulky compressive dressing with a splint in neutral position. The patient is made non-weight bearing. The patient is scheduled for his/her first postoperative visit in 1 week. At this appointment, the incisional VAC is removed and the patient is placed in a short leg cast for 2 additional weeks. At the third postoperative week, the sutures are removed if the wound is healing uneventfully. The patient is placed in a CAM boot and allowed non-weight bearing range of motion exercises. At week 6, progressive weight bearing in a CAM and physical therapy is initiated.

**RESULTS**

There are multiple TAA systems available in the United States. The Salto-Talaris TAA is a useful, fixed-bearing treatment modality for end-stage ankle arthritis. In a recent study by Schweitzer et al., the early results of the Salto-Talaris TAA were encouraging. At a mean follow-up of 2.81 years, they found an implant survival of 96%. These results are similar to those of a study in 2004 that looked at 93 Salto (mobile bearing) prostheses from 1997 to 2000. Bonnin et al. clinically and radiographically examined patients at a mean follow-up time of 35 months and found a survivorship of 95%.

Queen et al. looked at changes in pain, function, and gait mechanics with a 2-year follow-up of fixed-bearing total ankle systems. In this study, they prospectively observed 51 patients (28 patients received a Salto-Talaris) and found significant improvement in gait mechanics, pain reduction, and function. The gait changes observed were maintained at both 1- and 2-year follow-ups.

Even though there is not an abundance of literature specifically relating to the Salto-Talaris TAA system, the short-term survivorship and functional improvement are very promising.
REFERENCES

2. Easley ME. *Operative Techniques in Foot and Ankle Surgery*. 2010.