CHAPTER **53**

THE BUECHEL-PAPPAS TOTAL ANKLE JOINT REPLACEMENT: Report on Fifty-Seven Cases

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INTRODUCTION

Total ankle replacement (TAR) has been in use since 1970 as a treatment option for painful and degenerative ankle arthritis.[1] Originally, the procedure provided many patients with significant pain relief and offered limited mobility of their ankle joint. However, a high failure rate was observed in the early ankle implants within a few years of implantation. Unlike knee and hip replacements that were well established during the same time period, TAR was almost abandoned and used only in limited, special cases.[2] Due to poor results encountered with the first generation implants, the recognized treatment for painful, degenerative joint disease, ankle arthrodesis, was again the treatment of choice.[3]

Early failures of first generation ankle implants may be attributed to several factors related to implant design and implantation technique. Many of the early implants were either constrained, providing greater stability with reduced ankle motion, or unconstrained more motion with lessened stability at the bone-cement implant interface. Implantation technique required significant bone resection and relied on bone cement for prosthesis fixation in the tibia and talus. The original techniques and prosthetic devices did not completely take into consideration the complex anatomy and biomechanics of the ankle joint, thus contributing to early failure.

Diligent study of normal ankle biomechanics and review of previous failures led to the development of a new generation of implants. The newer implants provide a better means of dissipating the rotational forces at the joint surface by using a meniscus-like bearing between the tibial and talar components, while maintaining the integrity and stability of the joint.[4-7] This, coupled with improved cementless fixation, led to prosthesis designs that allow for more anatomic ankle motion with decreased rates of implant failure.[8]

Currently, there are 10 ankle joint prostheses in use around the world. The Agility (DuPuy, Warsaw, Ind.) STAR (Waldmar Link, Hamburg), Buechel-Pappas (Endotec, Orange, NJ), Salto (Tornier, France), Alpha OSG (Alphamed, Austria), AES (Biomet, France), Albatros (Groupe Lepine, France), Hintermann (New Deal, Switzerland), Ramses (FH, France), and a ceramic design used in Japan. The author (MHF) has hands-on surgical experience with the first six types listed above over the past five years, in six countries and the United States encompassing 110+ collective cases.

The BP ankle has been undergoing FDA clinical investigational trials in the United States since October of 1998. Implant designer Frederick Buechel, MD has been implanting the device for 18 years in the United States. Surgeons in Europe have been implanting the BP TAR for over 15 years. The focus of this paper is to discuss the author's experience with the BP TAR. A review of basic ankle biomechanics, the history behind the BP prosthesis, previous BP results, implantation technique, and the author's results are presented.

ANKLE BIOMECHANICS

Understanding biomechanics of the ankle joint plays a pivotal role in the design and function of total ankle replacements. Motion and stability of the ankle joint are essential for normal function during gait. The ankle has two degrees of motion and three degrees of stability.[9](Figure 1).

The two degrees of ankle motion are plantar-dorsiflexion and internal-external (axial) rotation.[10-14]

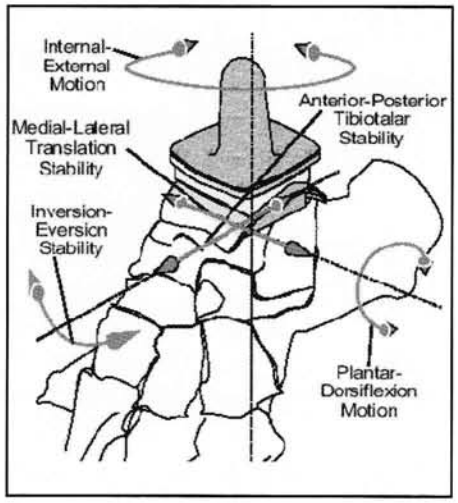

Figure 1. Degrees of Motion and Stability (From Drs. B-P, Design Rationale, with permission).

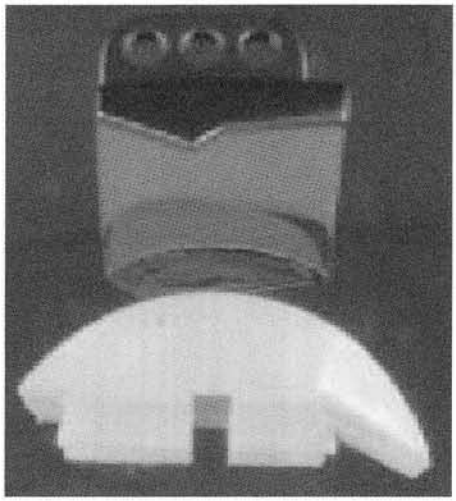

Figure 2. Cylindrical Device (1974) (Drs. B-P with permission).

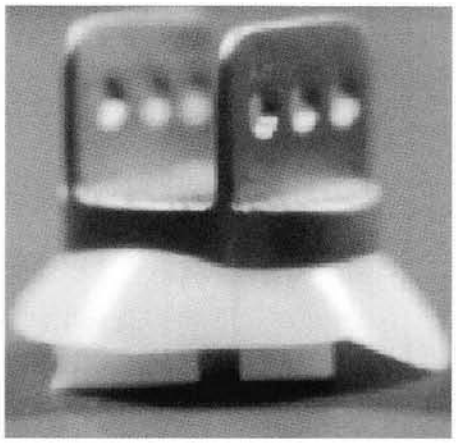

Figure 3. Spherical Device (1975) (Drs. B-P with permission).

An inversion-eversion component is also apparent, but Lundberg[15] described the greater portion of this motion as being associated with the subtalar joint.

The normal ankle joint is stable and constrained from significant motion in three degrees: anterior-posterior, medial-lateral, and inversion-eversion. This is accomplished by intrinsic and extrinsic factors. Both the anterior-posterior and inversion-eversion motions of the ankle are constrained by extrinsic ligaments about the ankle. Medial-lateral movement depends upon the intrinsic support of the ankle mortise itself by the medial and lateral malleolus.

Ankle implant devices must take into consideration the above factors of motion and stability in order to provide near-anatomic motion around the joint. Previous devices did not completely provide for the important rotational (axial) forces and failed to totally consider and design for the intrinsic and extrinsic anatomic stability of the ankle mortise.

THE BUECHEL-PAPPAS TAR

Fredrick Buechel MD, and Michael Pappas PhD developed and implanted their first ankle design in 1974.[16] (Figure 2) The implant consisted of a two-piece cylindrical device that was highly constrained and did not provide for axial rotation present in the ankle. The constraint and excessive torque produced in this early implant led to loosening of the components and some early implant failures.

In 1975 Buechel and Pappas[17] produced a second two-piece spherical designed that provided axial rotation but was partially inherently unstable (Figure 3). The lack of complete stability produced significant stresses on the extrinsic support structures leading to pain and early loss of function in some cases.

These early problems led to the development of a new three-piece device in 1976. The Trunion Ankle Replacement used mobile bearing technology to provide free axial rotational movement as well as stability with congruent contact surfaces (Figure 4).

Further refinement of the bearing technology produced the Mark I Meniscal Bearing Ankle Replacement (New Jersey Low Contact Stress TAR), first implanted in 1978 by Buechel. (Figure 5). The device consisted of a stemmed tibial component, a mobile bearing, and a grooved sulcus in the talar component with a single fin for talar fixation.

The experience gained from implanting the

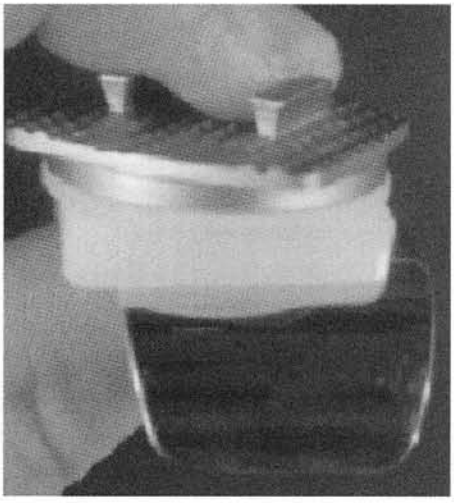

Figure 4. The Trunion Device (1976) (Drs. B-P with permission).

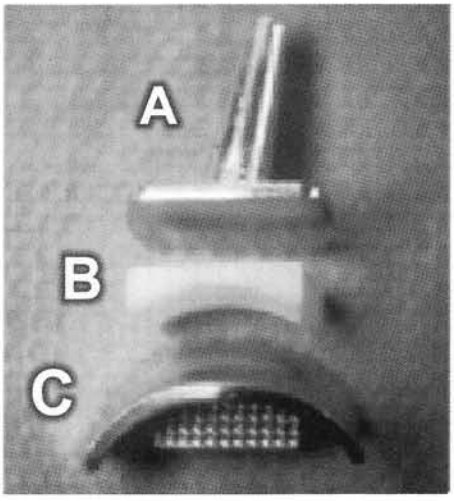

Figure 5. Mark I Design (1978) A. Tibial Component. B. Bearing. C. Talar Component. (Drs. B-P with permission).

Mark I design for over ten years was used to develop the Mark II design in 1989. Several modifications contributed to the current Mark II Meniscal Bearing Ankle Replacement, referred to as the Buechel-Pappas TAR. The following improvements were made: 1) A second talar fin was added to reduce the risk of talar necrosis, and add stability; 2) the talar component's tibial sulcus was deepened to reduce early problems of bearing subluxation; 3) due to early observation of high stress loads at the tibial component's platform edges, the platform thickness was increased; 4) use of titanium alloy and ceramic coating technology developed by Drs. Buechel and Pappas provided reduced contact wear; 5) and application of an improved porous coating at the bone contact area for better bony ingrowth, providing a more solid fixation surface.[18,19]

As described above, the current BP TAR is a three-piece mobile implant (Figures 6, 7). The current design of the articulating surface of the tibial component consists of a flat loading plate with a single fixation stem at a 7° anterior incline. The articular surface of the talar component has a convex superior surface with a central trochlear groove. The talar fixation surface has two anchoring stems, which allows for minimal talar resection and decreased risk of talar avascular necrosis. A thick talar component may also be implanted in cases of talar AVN or when the talar bone stock has been previously reduced or is absent. In cases where the talus is absent, the thick talar component is seated directly on the calcaneus (Figure 9).

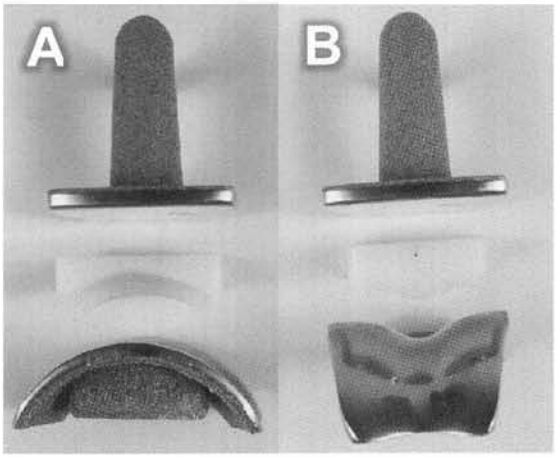

Figure 6. Mark II Design (1989), current BP TAR. A. Lateral B. Anterior view (Endotec™ with permission).

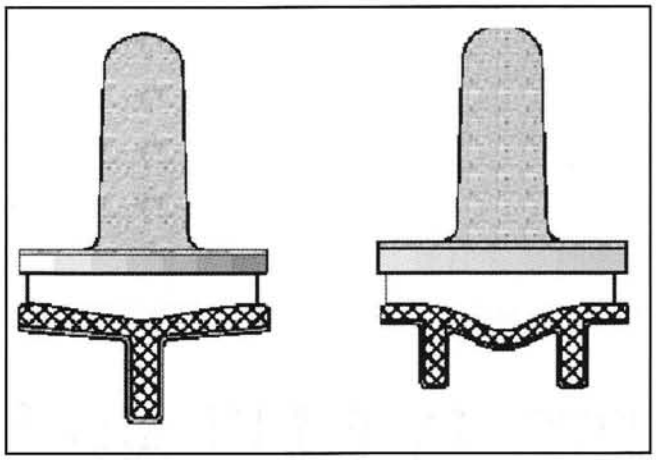

Figure 7. Differences between Mark I (A), single fin with shallow sulcus and Mark II (B) dual fin and deep sulcus. (BP Design Rationale, wtih permission.

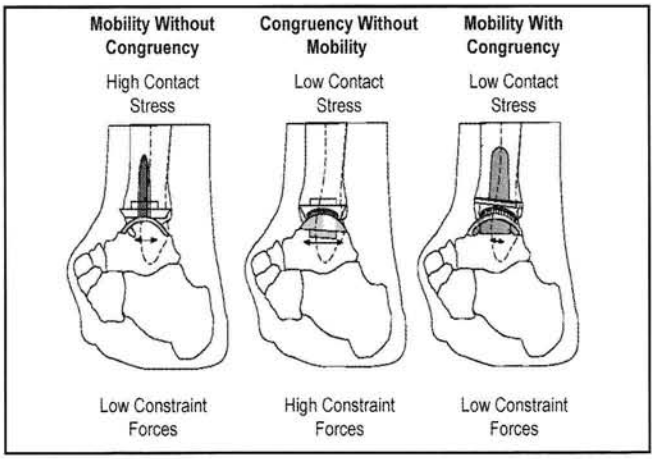

Figure 8. Design allows for mobility with congruency, providing a low-stree environment. (From BP Design Rationale, with permission).

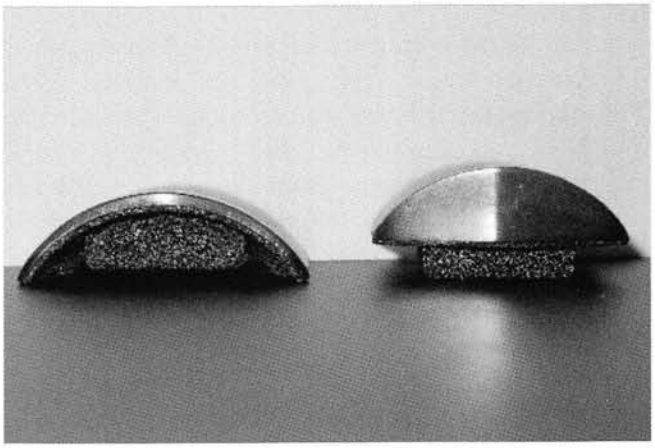

Figure 9. (A) Regual B-P talar component, (B) thick talar component. (Endotec, Orange, N.J.).

The meniscal bearing articulates congruently with both components matching both the flat tibial surface and the trochlear talar surface. The tibial and talar components are made of titanium alloy coated with a titanium nitride ceramic coating. The tibial and talar components have a titanium porous coating at the implant-bone interface. Fixation of both the tibial and talar components is via the titanium nitride coated porous beads. Bony ingrowth is complete in 6 weeks.The current BP TAR provides mobility with congruency, avoiding many of the problems of the past (Figure 8).

KINEMATIC STUDY OF THE MOBILE-BEARING TAR

In an effort to evaluate the mobile-bearing implanted ankle, a study by Komistek et al,[20] confirmed anatomic observations of axial rotation about the ankle joint. This was accomplished by evaluating the ankle range of motion of patients who underwent unilateral mobile-bearing TAR. The study included evaluation of translation and rotational motions of the distal tibia relative to the talus in the sagittal and frontal planes. They studied 10 subjects each having a normal ankle and a BP TAR. Patients were studied in vivo weight bearing conditions using video fluoroscopy in which each patient moved their ankle from maximum dorsiflexion to maximum plantar flexion.

Their report concluded that at maximum dorsiflexion both the normal and implanted ankles had similar sagittal midline talar contact positions, but with plantar flexion the implanted ankles had increased posterior talar contact. They also reported that the implanted ankles experienced rotational and translational motions similar to the patient's normal ankle joint. The authors noted that the increased posterior talar contact might have been due to surgical positioning of the implant or alterations of ligamentous tension.

EARLY BUECHEL-PAPPAS RESULTS

Buechel and Pappas[21] presented their original study that included 23 of the non-cemented New Jersey Low Contact Stress TARs (Mark I design) from December 1981 to December 1988. The age range was 21 to 89, mean 56. Follow-up ranged from 24 to 64 months, mean 35.3 months. Diagnoses included rheumatoid arthritis, 6 (26.1%); osteoarthritis, 4 (17.4%); post-traumatic arthritis, 10 (43.5%); avascular necrosis of the talus, 2 (8.7%), and painful ankle fusion, 1 patient (4.3%). Pain was the primary reason for surgery in all cases. Postoperatively, 87% of ankles had no pain or, at most, mild pain. Postoperative complications included poor wound healing in 4 ankles, reflex sympathetic dystrophy in 2, deep infection in 1, and 1 bearing subluxation. No ankle replacements were removed and no fusions were performed for failed implants, although one bearing was exchanged without disrupting the metallic elements. In their report, the suggestion was made that total ankle arthroplasty may have an improved application in various arthritic disorders when used with biologic fixation and unconstrained mobile bearings.

A second study by Buechel and Pappas(22) was later published using a deeper talar sulcus modifi-

cation (Mark II, current B-P TAR). The study consisted of 14 deep sulcus total ankle replacements in 13 patients from April 1989 to January 1991. Preoperative diagnoses consisted of: osteoarthritis 7 (50%), rheumatoid arthritis 2 (14%), and 5 patients (36%) with post-traumatic arthritis. The age range was 28-80 years, mean 54. The results of the deep-sulcus design were: 13 (93%) good to excellent and one (7%) fair. One posttraumatic patient continues to have chronic tibial pain with radiolucency about the tibial component stem.

The 10-year survivorship for the initial shallow sulcus design was 94.75%, while demonstrating 85% good to excellent clinical results. The 3-year survivorship for the deep sulcus design was 100% with no subluxation or talar component subsidence noted. Furthermore, the clinical results were good to excellent in 92.9%, with one patient complaining of residual tibial pain.

In their most recent publication Buechel and Pappas[23] presented the overall results for the shallow-sulcus and deep-sulcus implants. The overall results of the shallow-sulcus design with follow-up (2-18 years; mean, 10 years) were 28 (70%) good to excellent, 2 (5%) fair, and 10 (25%) poor. The overall results of the deep-sulcus design with follow-up (2 to 10 years; mean, 5 years) were 44 (88%) good to excellent, 3 (6%) fair, and 3 (6%) poor. The complications encountered were: delayed wound healing, talar component subsidence, bearing subluxation, severe bearing wear, malleolar fracture, infection, and RSD. The 18-year survivorship for the shallow-sulcus design was 74.2% and the 10-year survivorship for the deep-sulcus design was 93.5%.

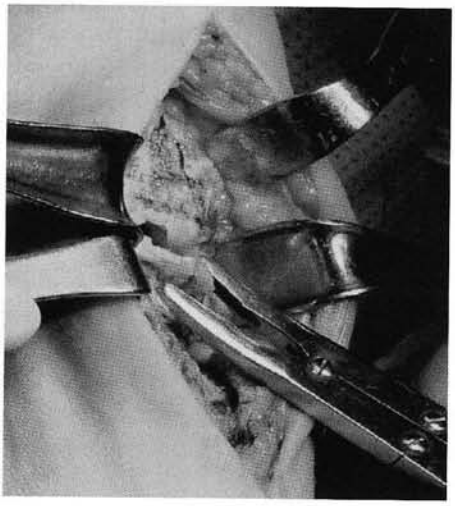

Figure 10. The tibial and talar osteophytes seen here are resected using a rongeur to identify the anterior joint line.

INDICATIONS

Indications include rheumatoid arthritis, post-traumatic arthritis, primary osteoarthritis, talar AVN, failed ankle fusion, and fusion "take-downs" in patients who no longer want the fusion. In such patients, the fibula must be present with intact or reconstructable lateral ligaments. A thick talar component is available for use in specific cases when the overall bone stock is poor or the talus is missing (Figure 9).

Joint replacement was typically reserved for older patients. The BP ankle has been used in patients as young as 15 for the severe symptoms of juvenile rheumatoid arthritis.

IMPLANTATION TECHNIQUE

TAR is performed under general or spinal anesthesia. Fluoroscopic examination is used throughout the entire procedure to verify placement of the bone cuts and positioning of the implant. The patient is placed in a supine position with a sandbag under the hip of the operative side to place the patella in a rectus position. A thigh tourniquet is used. Prep to above the knee and standard procedures are followed to drape the extremity.

For maximum exposure an anterior approach is used. A 10-13cm. linear incision is made on the anterior aspect of the ankle between the tendons of the tibialis anterior and extensor hallucis longus. The incision is deepened through the subcutaneous tissue with care to protect the superficial peroneal nerve. The superior and inferior extensor retinaculum are identified and incised and the incision deepened to the tibia and talus. The anterior neurovascular structures are retracted laterally in the soft tissue. Exposed tendons are kept moist with saline soaked sponges. Bone exposure of the tibia should be proximal enough to ensure room for the tibial window above the plafond (approximately 4 cm) and should include the medial and lateral gutters. Distally the talus should be exposed to visualize about half of the talar neck. Once exposure is achieved, any tibial or talar osteophytes are resected using a rongeur or power burr to expose the anterior joint line (Figure 10).

Following resection of any osteophytic or exogenous bone around the ankle joint, the level of tibial pathology is determined by visual inspection. Next, the Tibial Marking Osteotome is placed

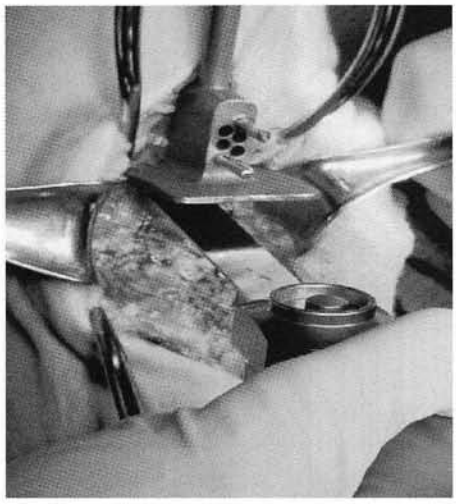

Figure 11. The tibial resection guide is used to make the first cut.

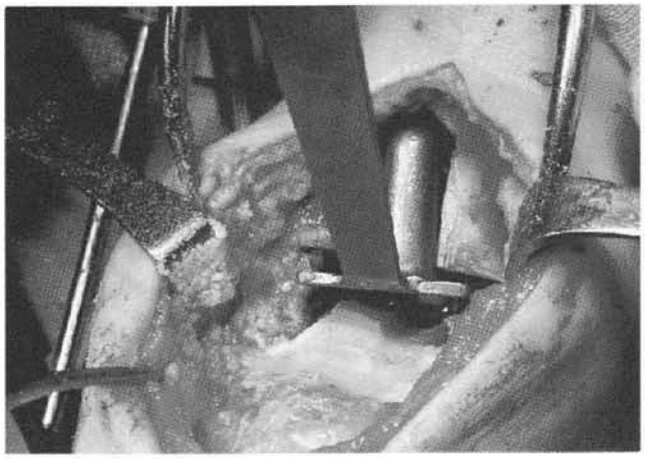

Figure 12. The Tibial Trial resection guide is used to make the first cut.

parallel to the articular surface and centered on the tibia. The Tibial Marking Osteotome is impacted to mark out and begin the cut on the distal tibia. The Tibial Resection Guide with its 7 degree inclined cutting surface is placed 10 mm proximal to the plafond and pinned into place. A through and through tibial cut is then made with a bone saw from anterior to posterior being careful to not fracture the medial or lateral malleolus (Figure 11). Posterior soft tissue structures (especially the posterior medial neurovascular bundle) are kept in mind as the posterior cortex is cut. Depending on the concavity of the distal tibial plafond on a lateral x-ray, approximately 1 cm of distal tibia is resected. Vertical medial and lateral tibial cuts are completed with a smaller saw blade or osteotome. The distal tibia is carefully resected using small osteotomes and a pituitary rongeurs. Fluoroscopy will help ensure all the posterior fragments are properly removed.

Next, the Tibial Window Osteotome is used to fashion an anterior cortical window in the distal tibia for introduction of the Tibial Component Fixating Stem. The tibia is impacted with the osteotome to outline the cortical window. A reciprocating power saw and small cranial burr are used to complete the cuts down to the center of the tibial shaft in the lateral plane. The cortical window is removed and placed in a separate saline/antibiotic filled cup for later reinsertion. A curette or burr is used to deepen the central channel in the tibial canal to approximately one-inch in depth. The Tibial Trial is inserted and should sit with the base plate flush against the tibia with the stem snug in the central channel (Figure 12). In the anterior to posterior plane the stem should sit centrally in the tibia from medial to lateral and anterior to posterior.

The talar cuts are made beginning with the talar sulcus burr. A 10 mm burr is used to fashion an anterior to posterior central sulcus in the talus (Figure 13). The Talar Sulcus Rasp ensures adequate depth and width to allow the talar component to contact as much of the talus as possible. The talar fin slots are marked and cut with a reciprocating saw. After adequate depth of these channels has been achieved, the Talar Trial is seated to ensure a good and snug fit. The talar component should sit posteriorly enough so that when the ankle is dorsiflexed, the anterior edge of the talar component should be on the same plane as the anterior edge of the tibia. Appropriate medial to lateral size is determined by choosing a component that will rest on the medial and lateral cortices of the talar walls, without hanging over the edge impinging the medial and lateral gutters.

Finally, the appropriate meniscal bearing size is determined by first, inserting the tibial and talar trial components. A minimum bearing height of 5mm. is preferred. Second, the Cylindrical Sliding Bearing Trial is inserted in varying heights. The bearing should fit very snug between the tibial and talar trial and often requires a bit of force. Too small of a bearing will predispose to ligament laxity and even subluxation of the bearing. Too large of a bearing may cause the ligaments to be too taut and can limit dorsiflexion.

After the final components are inserted a final fluoroscopic/x-ray exam is performed to ensure proper size and placement. Joint motion is tested to

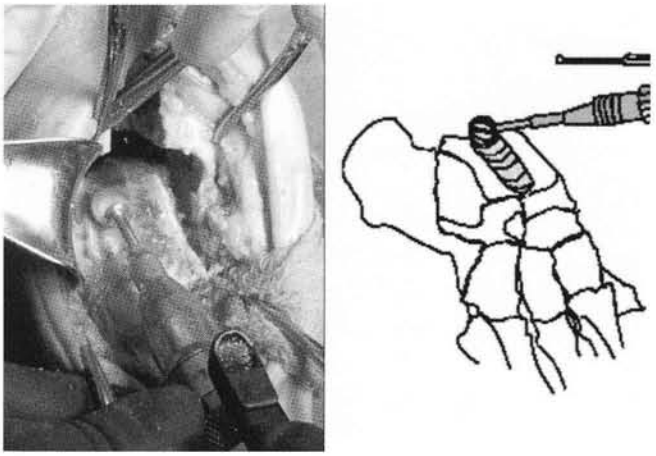

Figure 13. A power bur is used to fashion the central groove in the talus.

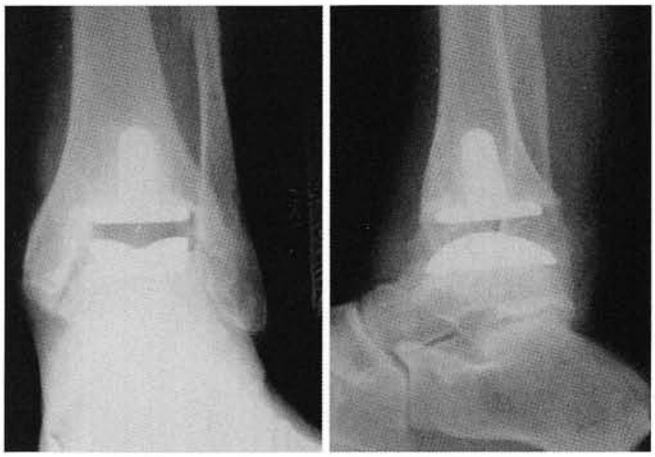

Figure 14. AP and Lat x-rays of properly fitted componets. The "dots" are metal in the meniscus to show its location between the tibial and talar components.

make sure it can achieve the required 10 degrees of dorsiflexion (Figure 14). If not a TAL is performed. After the range of motion has been checked the tibial window and any necessary bone graft is then replaced and the wound is closed over a hemovac drain. Non-absorbable Ethibond is used to close the ankle joint capsule and the extensor retinaculum. Nylon is used for skin closure. The ankle is infiltrated with Marcaine, plain, prior to applying a well-padded below-knee fiberglass cast with the ankle at 90 degrees. IV Fortaz and Vancomycin for 3 days, nasal oxygen, 6L/minute during the postoperative course, and Indocin, 25mg BID for 3 days, complete the post op regimen. The cast is changed as needed during the non-weight bearing 6 week post operative period. At 6 weeks, patients bear full weight and are sent to rehabilitation. If a TAL or STJ fusion was done, full weight bearing is delayed for 10-12 weeks.

RESULTS IN 57 CASES

The current data appears very promising. At this writing 74 patients were implanted in the past 39 months. Of the 74 patients, 11 received the Doets-Feldman modified tibial component and were excluded from the study, as was one with bilateral implants. In addition, 4 patients were excluded due to incomplete data and two lost to follow-up. We report on 57 patients at 3, 6, 12, and 24-month postoperative periods pursuant to the required FDA timetable. The 57 patients include, 42 (74%) males and 15 (26%) females. The average age was 55, ranging from 15-83 years. Forty-seven of 57 (82%) had one or more prior surgical procedures on the implanted ankle. Diagnoses included post-traumatic osteoarthritis, 39 (68%); degenerative osteoarthritis, 14 (25%); rheumatoid arthritis, 4 (7%); 2 (3%) of the patients underwent a "take-down" of a previous ankle fusion.

Table 1

RESULTS OF ANKLE SCORES

Results					
	Pre-op	3 Mo Post-op	6 Mo Post-op	1 Yr Post-op	2 Yr Post-op
# of Patients	57	57 (100%)	54 (95%)	38 (66%)	16 (30%)
POOR	57/57 100%	7/57 (13%)	4/54 (7%)	2/38 (5%)	0/16 (0%)
FAIR		10/57 (17%)	1/54 (1%)	4/38 (10%)	2/16 (12%)
GOOD		16/57 (28%)	18/54 (33%)	13/38 (34%)	1/16 (6%)
EXCELLENT		24/57 (42%)	30/54 (55%)	19/38 (50%)	13/16 (81%)

SCORES

Prior to surgery each patient was evaluated using the New Jersey Orthopedic Hospital Ankle Evaluation Form (NJOHAEF) to derive a baseline ankle score.[21] The same form was used to evaluate patients at 3 months, 6 months, one-year, and two-years postoperative. The scores were then used to

demonstrate changes in preoperative versus postoperative subjective and objective information. This form attempts to measure function, pain level, range of motion, and the amount of deformity present in the ankle. The form is based on a 100 point scale with a score below 59 representing poor; 60 to 69, fair; 70 to 84, good; and 85 to 100, excellent.

At this writing, 57 (100%) of the patients have data collected at the 3-month interval, 54 (95%) at 6-months, 38 (66%) at 12-months, and 16 (28%) at the 24-month interval postoperatively.

A combined average improvement of 35% over preoperative baseline scores was noted at the first interval. The average results at the first 3-month interval were 40/57 (70%) good to excellent, 10/57 (17%) fair, and 7/57 (13%) poor. At the 6-month interval the average results were 48/54 (84%) good to excellent, 1/54 (1%) fair, 4/54 (7%) poor. At the 12-month interval the results were 32/38 (84%) good to excellent, 4/38 (10%) fair, 2/38 (5%) poor. The last 24-month interval showed 14/16 (88%) good to excellent, 2/16 (13%) fair, and 0/16 (0%) poor (Table 1).

The conclusion from the data shows that 14 of 16 (88%) are at 2-years postoperative and either have mild pain or are completely pain-free. Anecdotally, 9 of the 74 patients are over three years postoperative. All 9 are 85-95% pain-free, which we classify as excellent. One of the 9 weighs over 360 pounds.

COMPLICATIONS

Twenty-six complications occurred in 12 patients either at surgery or postoperatively. The most serious was failure, defined as implant removal and ankle fusion. There was one failure, due to intraoperative lateral malleolar fracture, (in a revision patient), ORIF 3 months post implant revision, subsequent osteomyelitis 7 weeks post ORIF leading to implant removal and fusion. One case of subtalar fusion non-union and medial malleolar fracture was treated by ORIF and revision with bone grafting and a score of good at 18 months postoperative. One case of 1 year preoperative osteomyelitis recurrence 3 months post-implant, was treated by IV antibiotics with full resolution of infection and a score of excellent at 2 years postoperative. Two cases of delayed wound healing required skin grafts and are doing excellent at 3 years postoperative. Since the use of non-absorbable sutures began there have been no delayed wound healing cases. Two cases of superficial infections and 1 deep infection occurred and all resolved with IV antibiotics.

Six cases had intraoperative medial or lateral malleolar fractures. As patients are casted, these fractures are not fixated if alignment is satisfactory. Two required subsequent ORIF with good scores at 1 and 2 years postoperative. The etiology is saw blade excursion into the malleoli during resection of the distal tibia. This complication is known to be 10% worldwide with the BP and Star implants. It should be eliminated with saw blade capture plates or extensions on the tibial cutting guide now in design changes. Six patients have prolonged tendonitis of either posterior tibial or peroneal tendons as they begin to function with the implant. This condition may last for a year or more. Their scores are good to excellent at 1 and 2 years postoperative. In one patient, the posterior tibial artery was severed and re-anastamosed with a score of good at 1 year postoperative. Two patients have posterior tibial nerve neuritis over 1 year postoperative, which is gradually subsiding; both scores are good. There were two cases of misalignment of the talar component requiring reposition and are good at 1 year post revision. Two cases of heterotropic bone formation of the tibia required bone excision and radiation with 800 RADS at the tibial site. Three patients have a residual 10/15 degree varus deformity and will require revision at some future time. Despite these complications, only 2 patients had a poor result at 1 year postoperative and none at 2 years. It may be concluded that the intraoperative complications enumerated have not caused implant failure or poor results.

Adjunctive Procedures

Adjunctive procedures were necessary in 21/57 (37%) of the patients included in the results (Table 2). These procedures ranged from lengthening of the Achilles tendon to triple arthrodesis of the hindfoot. A total of 26 adjunctive procedures were performed at the time of total ankle replacement. Through the first 10 cases, only a TAL was performed at the time of TAR, if needed, even with the presence of subtalar joint disease. In these patients, it was axiomatic, due to preoperative x-rays, that the patient would need a fusion at a later date, and I began to do the fusions at the time of TAR. It is important to place the prosthesis on a

Table 2

ADJUNCTIVE PROCEDURES PERFORMED AT THE TIME OF TAR

Procedure	# of cases
Tendo Achilles Lengthening	8
ORIF for introp fx	3
Dwyer Calcaneal Osteotomy	2
Subtalar Fusion	6
Talonavicular Fusion	3
Lateral Ankle Stabilization	3
Triple Arthrodesis	1
Total # of Procedures of adjunctive procedures	**26**
Total # of patients requiring adjunctive procedures	**21**

Table 3

THE KEYS TO SUCCESSFUL LONG-TERM RESULTS

- Due to the steep learning curve of TAR, joint replacement surgeons who plan to consistently perform TARs should perform this procedure.
- Appropriate patient selection, and correction of co-existent deformities.
- Complete patient understanding and compliance with the operative post course is crucial to the ultimate success of TAR
- A high level of communication between the joint replacement surgeon, the follow-up doctors and the therapists involved with these cases.

stable rectus "platform". The presence of severe STJ disease precludes this objective and concomitant fusion may be necessary.

CONCLUSION

The reported BP TAR studies published since 1988 lead to the conclusion that the procedure is a good to excellent alternative to fusion for long-term viability and function in more than 80% of patients. TAR failures in the 1970s and 1980s have caused many surgeons in America to not believe the reported results and refuse to reconsider the procedure. Even more unfortunate is the fact that in most cases patients are not informed of its availability so that it might be considered. Clearly, general availability of the procedure in the future will help to solve this problem. As in the past, this exceedingly complex procedure should be performed on a regular basis rather than infrequently, lest failure be blamed on the prosthesis rather than surgical infrequency. It is author's (MHF) position that current implants and the reported worldwide results are sufficient to endorse TAR as a viable treatment choice in patients with end-stage rheumatoid and osteoarthritic disease. At the very least the patient should be given the choice of fusion or implantation with sufficient references to both procedures so that an informed decision may be made. If fusions are performed, the fibula should be left intact. In this way a "takedown" may be performed years later if the patient chooses. The success of the BP and similar prostheses will endure if patients are selected properly and if surgeons are adequately trained. (Table 3)

Further studies with longer-term results are necessary to determine the limiting factors for the current prostheses in use around the world. The overall results of our study thus far are promising. It is obvious that this current design is far superior to the ankle implants of the past. Clearly, the results of the reported Buechel-Pappas implants in Europe have been duplicated in the United States.(24) It remains now for the FDA to approve its use by additional foot and ankle surgeons.

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