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The CORE Foot and Ankle Advanced Reconstruction Fellowship, Phoenix , AZ

## Statement of Purpose

Avascular necrosis (AVN) is a difficult pathology to treat, with limited surgical options. A novel treatment option for progressive AVN of the tibia, talus, and calcaneus is total talus replacement with total ankle replacement (TAR). The purpose of this poster is to present a case and demonstrate its viability as a treatment option.

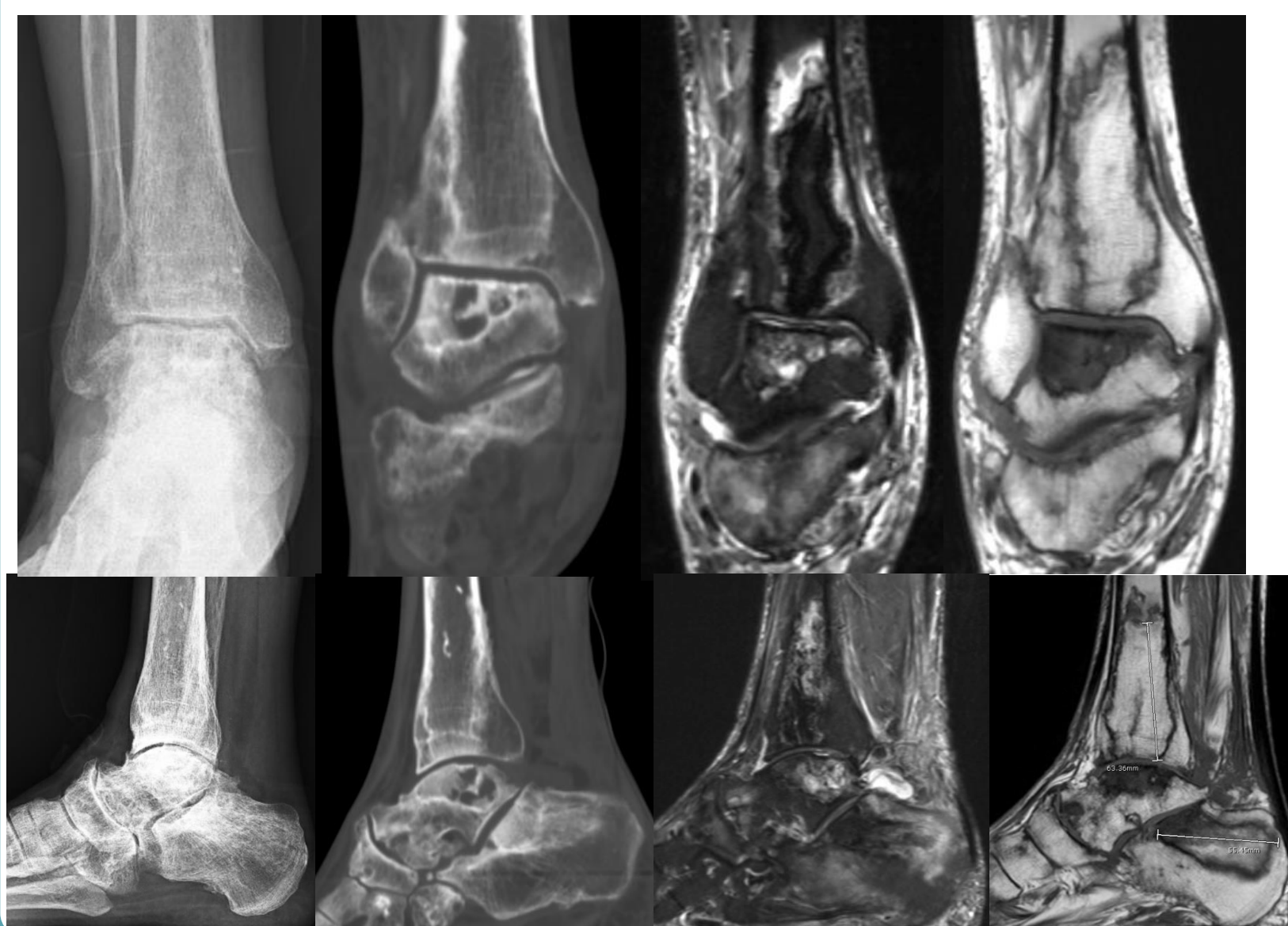
## Literature Review

AVN of the talus remains a challenge to the foot and ankle surgeon with limited treatment options. These options are further limited as the AVN becomes more extensive. Arthrodesis of the ankle or rearfoot, as well as tibiocalcaneal arthrodesis with talectomy, are potential treatment options. These salvage procedures can produce severe disability for the patient with development of gait abnormalities and secondary arthritis in adjacent joints (1,2,3,5,8).

Harnroongroj et al. introduced a talar body prosthesis used for talar AVN and reported a median AOFAS score of >75 (4). Taniguchi et al. described use of a total talar prosthesis with favorable results and maintenance of ankle function (9). Although the results have been promising, its use is questionable with concomitant AVN of the tibia and/or calcaneus. Kanzaki et al. recently reported positive results of TAR with total talus prosthesis for AVN with ankle and subtalar joint degeneration (5).

3D printing technology has presented new concepts in orthopedic surgery. It has been successfully adopted in the reconstruction of the musculoskeletal system (1,3). In our case, a custom-made talar prosthesis was produced based on the patient's anatomy and the articulation geometrics of a tibial ankle prosthesis. We present a case of AVN of the tibia, talus, and calcaneus treated with total talus replacement with ankle arthroplasty.

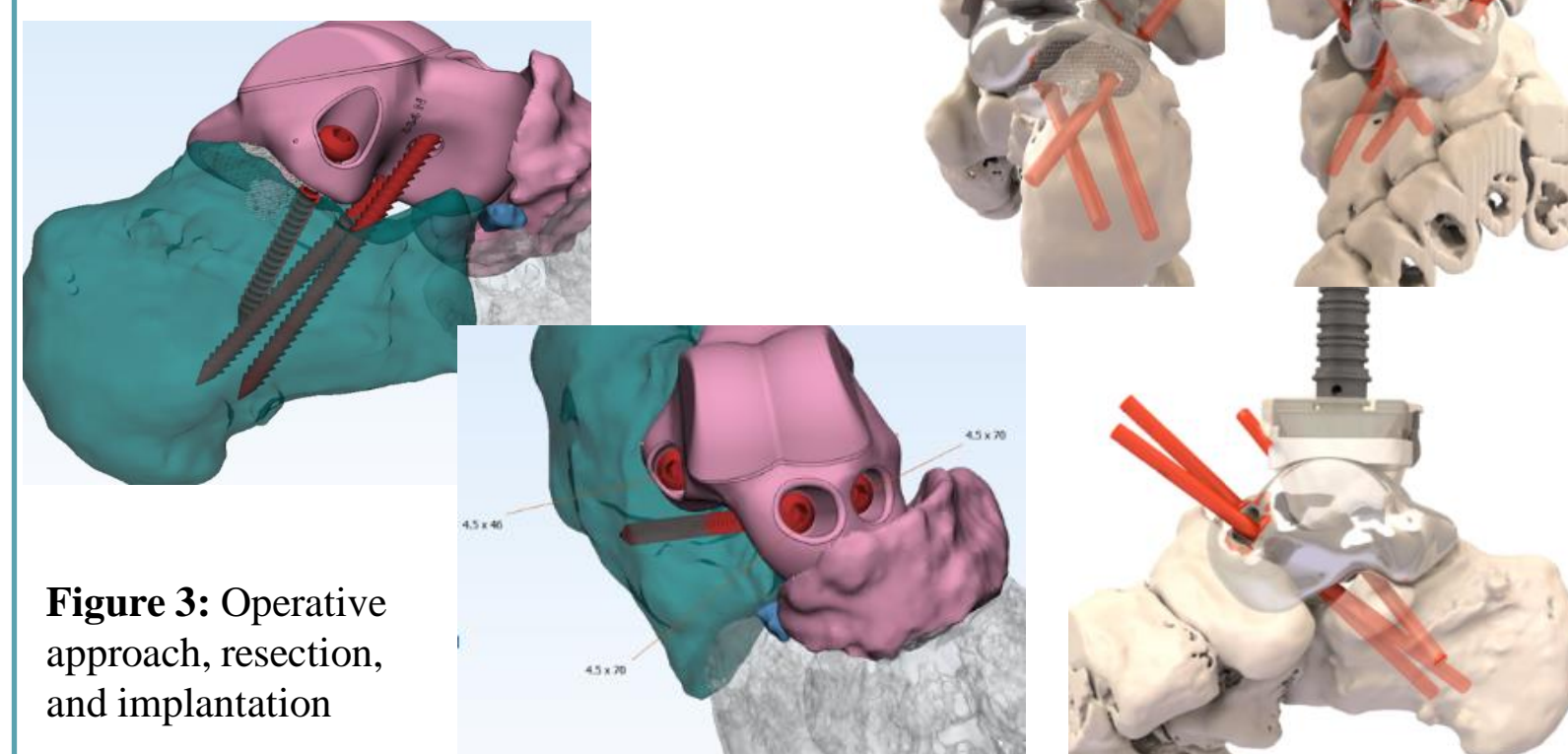
**Figure 1:** Pre-operative ankle radiograph, CT, and MRI demonstrating extensive, multifocal infarcts of the tibia, talus, and calcaneus with areas of subchondral collapse



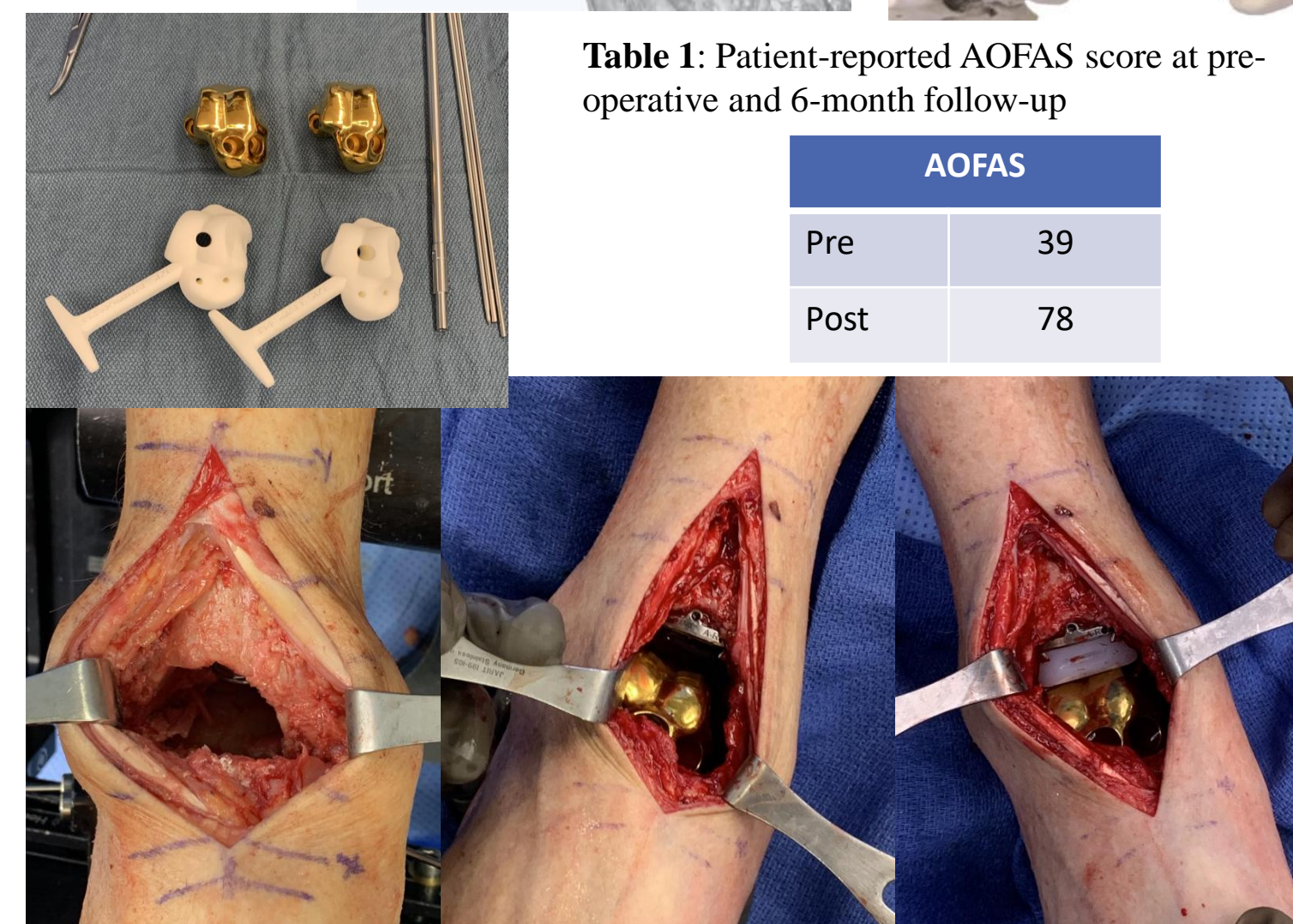
## Case Study

A 34 year old male presented with bilateral ankle pain for over 10 years with history of leukemia, treated with radiation and chemotherapy, bone marrow transplant, and long-term steroids. Patient subsequently developed AVN of the hips, knees and ankles. CT and MRI revealed extensive bone infarcts involving the distal tibia, talus, and calcaneus with areas of subchondral collapse of the ankle and subtalar joint. Patient refused a below knee amputation. Due to the extent of osteonecrosis, we believe an arthrodesis would likely result in continued pain and possibly amputation. We believe that a 3D printed custom total talus prosthesis with a TAR medullary tibial component would give him the best chance to maintain quality of life and function.

**Figure 2:** Pre-operative talus templates demonstrating articulation with medullary tibial component and design for calcaneal fixation



**Figure 3:** Operative approach, resection, and implantation



**Table 1:** Patient-reported AOFAS score at pre-operative and 6-month follow-up

AOFAS	
Pre	39
Post	78

## Case Study

A modular prosthesis was designed from CT scan of the talus. The prosthesis was designed and manufactured with 3D printing technique. The superior articular surface was designed to articulate with the poly of a medullary stem total ankle prosthesis. The talar prosthesis provided screw holes to allow for subtalar fusion fixation. The inferior articular surface was coated and latticed to allow for osseous ingrowth.

The ankle was accessed via an anterior approach. The tibia bone cuts were made using the TAR manufacturer's standard technique. The talus was then completely resected. A size 3 long tibial component was implanted after reaming the medullary canal. The articular surface of the calcaneus was then prepped for fusion. The talar prosthesis was inserted and position was confirmed under fluoroscopy. Two 4.5mm screws were placed through holes in the talar neck and one 4.5mm screw was placed through the lateral process, achieving excellent compression. An 8mm poly was inserted and a layered closure was performed.

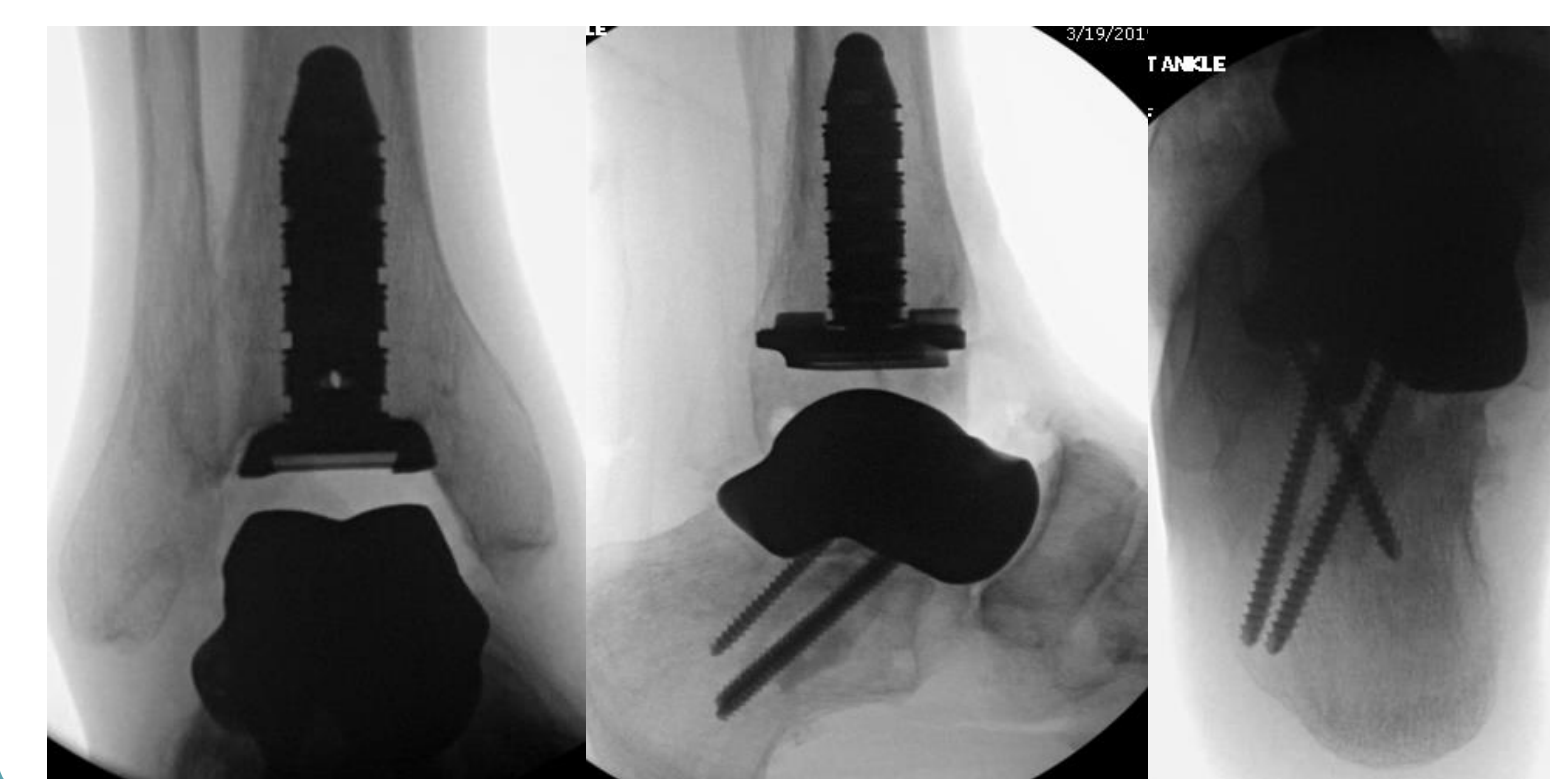
The ankle was placed in a cast at one week follow-up and transitioned into a boot at the three week mark to allow for active and passive range of motion exercises. He was allowed full weightbearing in a CAM boot at the eight week follow-up and underwent aggressive functional rehab with physical therapy. Radiographs were obtained at each office visit and the implants maintained alignment without loosening throughout the post-operative period.

The patient's post-operative recovery was uneventful and the patient remains satisfied with the outcome. Comparing preoperative and one year follow-up results, ankle dorsiflexion had increased from 0 to 8°, plantarflexion was preserved at 15°, and total ankle range of motion increased from 15 to 23°. His VAS pain score decreased from 6 to 2. He also reported significant improvement in AOFAS and SF-36 scores (6,10).

**Table 2:** Patient-reported Short Form-36 scores at pre-operative and 6-month follow-up

	SF-36								
	Physical Function	Role Physical	Role Emotional	Energy Fatigue	Emotional	Social Function	Pain	General Health	Health Change
Pre	35	0	100	15	72	38	23	45	25
Post	55	100	100	55	88	100	68	25	75

**Figure 4:** Intra-operative AP, lateral, and calcaneal axial radiographs.



## Analysis & Discussion

We report a successful total talus replacement with ankle arthroplasty and subtalar joint arthrodesis in a young adult for treatment of AVN of the distal tibia, talus, and calcaneus. We believe that this is the first report of implantation of a custom total talus prosthesis and a medullary tibial component for ankle arthroplasty with this extensive AVN.

The advantages of total talus replacement with ankle arthroplasty are maintenance of leg length and function while alleviating pain (1,3,5,8). One disadvantage to this procedure is the high cost associated with custom 3D implants. One limitation of the study is that it only involves a single case in one patient with short-term follow-up. Remarkable ankle function and pain relief were obtained in our patient and we are optimistic that these results can be maintained over a longer term follow-up. We believe that total talus replacement with ankle arthroplasty is an acceptable surgical treatment for extensive AVN of the distal tibia, talus, and calcaneus.

**Figure 5:** Lateral, AP, and mortise radiographs of the ankle at 1 year follow-up



## References

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