



Surgical Treatment of Talar Avascular Necrosis with Custom 3D Printed Total Talus Replacement

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Statement of Purpose

Commonly avascular necrosis (AVN) of the talus is surgically treated with arthrodesis of the ankle and/or subtalar joint. The use of 3D printing has allowed for complete replacement of the talus with a custom patient specific total talus implant. The implant allows for maintained motion of the ankle and subtalar joint. This case study documents the surgical treatment of talar AVN using a custom 3D printed total talus implant made of cobalt chromium.

Literature Review

Total talus replacement has been described as a useful procedure in several case studies for the treatment of talar AVN as well as trauma involving the talus (1,3). Tracey et al. published a proof of concept study for the use of patient specific 3D printed total talus replacement for avascular necrosis (AVN) in 14 patients and demonstrated successful immediate deformity correction (3). Although larger studies are needed the use of 3D printed total talus implants presents a viable joint sparing salvage option.



Figure 1. (Above) Ankle radiographs of talar AVN

Case Study

31 year old patient with unilateral talar AVN secondary to talar neck fracture 7 years prior to presentation. Patient presented with right foot severe cavus deformity, inability to wear close toed shoes and unable to work. The patient failed conservative treatment. Due to collapse of the talus, a CT of the contralateral limb was obtained to create an inverted variant for nominal anatomy of the affected talus. Patient underwent right talectomy with replacement using a custom 3D printed total talus implant made from cobalt chrome. Concomitant procedures included lateral displacement calcaneal osteotomy, first ray dorsiflexory wedge osteotomy, plantar fasciotomy and gastrocnemius recession.

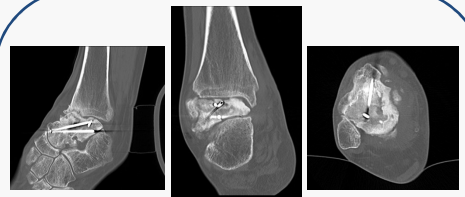


Figure 2. (Above) CT images of talar AVN secondary to trauma



Figure 3. (Above) Pre-operative clinical images of affected right foot and ankle

Results

Pre-operative AOFAS, ACFAS, PCS and MCS scores: 20, 3, 20.97 & 56.18, respectively. Post-operative scores at one year follow up: 78, 65, 50.53 & 52.43, respectively. AOFAS, ACFAS and PCS scores all increased at 1 year post-operative visit. MCS scores slightly decreased at one year post-operative. Current length of follow up: 20 months. Patient is now back at work and ambulating in normal close toed shoes with the assist of an ASO brace.

Discussion

Total talus replacement is a viable option for treatment of talar avascular necrosis while maintaining motion of the ankle and subtalar joint. The longevity of the adjacent joint surfaces on the implant determine future need for further surgical intervention. The type of metal implant used and ware characteristics of each metal on adjacent joints needs further investigation to allow for better longevity timelines. Other variations of the talar implant can be created to allow for incorporation of subtalar joint fusion as well as the implant's use with a tibial component from any total ankle replacement system, allowing for future salvage procedures.

References

1. Taniguchi A, Takakura Y, Sugimoto K, et al. The use of a ceramic talar body prosthesis in patients with aseptic necrosis of the talus. *J Bone Joint Surg Br.* 2012;94(11):1529-1533.
2. Taniguchi A, Takakura Y, Tanaka Y, et al. An alumina ceramic total talar prosthesis for osteonecrosis of the talus. *J Bone Joint Surg Am.* 2015;97:1348-1353.
3. Katsui, Ryuhei, et al. Ceramic Artificial Talus as the Initial Treatment for Comminuted Talar Fractures. *Foot & Ankle International*, Sept. 2019.
4. Tracey J, Arora D, Gross C, Parakh S. Custom 3D-printed total talar prostheses restore normal joint anatomy throughout the hindfoot. *Foot & Ankle Specialists*, 2018.
5. Horst F, Gilbert BJ, Nunley JA. Avascular necrosis of the talus: current treatment options. *Foot Ankle Clin.* 2004;9:757-773.

Financial Disclosures

Dr. Highlander is a consultant for Additive Orthopedics

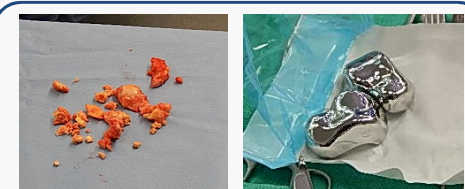


Figure 4. (Above) Resected talus; 2 sizes of talar implant



Figure 5. (Left) Range of motion after implantation of total talus implant

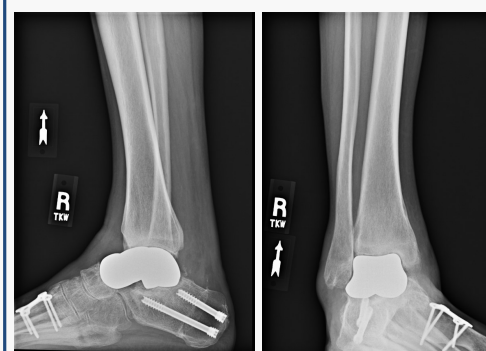


Figure 6. (Above) 20 months post-operative radiographs