A Novel Local Antibiotic Delivery / Prophylaxis System with PRF Matrix for Total Talus Replacement in Avascular Necrosis of the Talus

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Avascular necrosis (AVN), otherwise known as osteonecrosis, aseptic necrosis and ischaemic bone necrosis, is a bone disease characterised by the interruption of subchondral blood supply, leading to ischaemic damage and subsequent tissue necrosis.[1] AVN typically affects the epiphysis of long bones of weight-bearing joints; common sites include the femoral head, knee and talus.[1] The talus is predisposed to AVN due to its unique structure, characteristic extraosseous arterial sources, and variable intraosseous blood supply.[2]

A 58 year old male was referred with right ankle pain which had worsened over the preceding 3 years. Prior to referral, the patient received multiple steroid injections into the ankle for symptomatic relief. He mentioned that he was experiencing similar pain in his left ankle and both of his hips. The patient's ankles were duly investigated with further MRIs, the findings of which were consistent with avascular necrosis in both talar bodies, but more severe in the right talus (figure 1 and 2). The patient was managed conservatively until his referral to the author following a CT scan of his ankle in July 2023 (figure 3), which revealed a threatened collapse of the talar body. The patient had no typical risk factors associated with AVN in his past medical or family history.

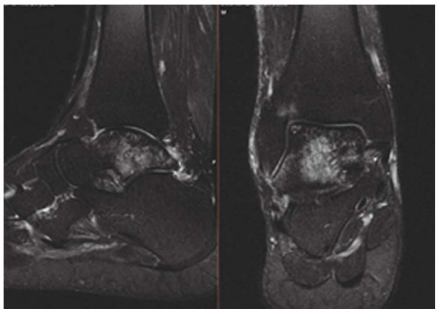

Fig. 1 Right Ankle MRI April 2021

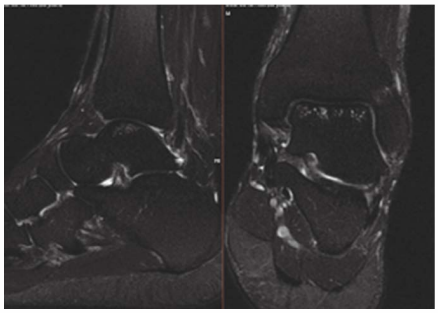

Fig. 2 Left Ankle MRI April 2021

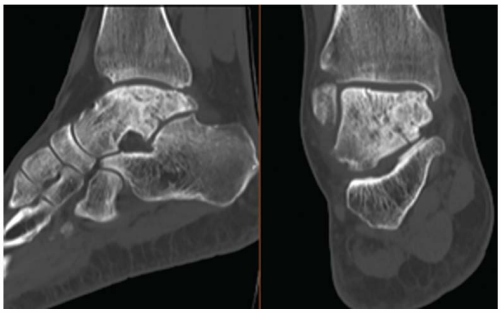

Fig. 3 Right Ankle CT July 2023

Different surgical options were discussed, including fusion of the ankle +/- subtalar joint, or a total talar replacement. A repeat MRI scan of the right ankle was performed to assess the subtalar joint for osteoarthritis; none was identified. The patient opted for the total talus replacement; therefore, a CT scan of the left ankle was performed to map out the 3D anatomy of his "normal" talus, which fortunately had not collapsed.

The custom total talus implant and spacer (figure 4) was designed and manufactured by Meshworks©, who have developed and adopted additive manufacturing techniques in order to produce custom made implants for the reconstruction of adult foot and ankle skeletal anatomy which has been compromised by deformity and/or bone loss. Different size implants were manufactured, along with corresponding size and fixture congruence template tools (figure 7) to ensure the correct fit. Due to the large implant load, there was concern about the potential for infection to develop, and considerable thought was given as to how a high load of local, bioavailable prophylactic antibiotic, with a sustained period of release, might be administered. Other recognised forms of local antibiotic delivery - such as calcium carriers – could not be used in this case due to their unsuitability in articulating surfaces or joints, and the fact that post-operative white exudate

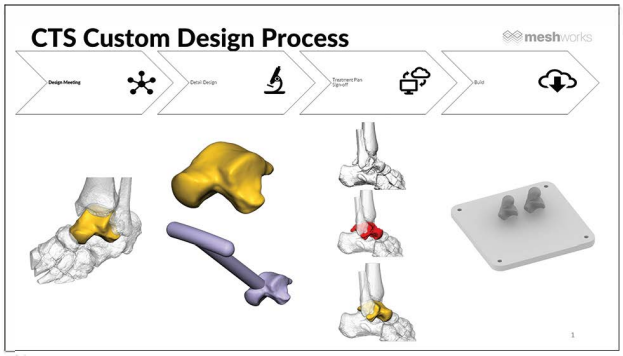

Fig. 4 Total Talus design algorithm

Continued overleaf

has been reported following their use[3,4]. The novel solution to this quandary came in the form of an autologous, easily prepared, platelet-rich fibrin (PRF) matrix which can which can effectively coat implants and prostheses, and also act as a carrier for liquid drug formulations such as antibiotics – ArthroZheal®.

Fig. 5

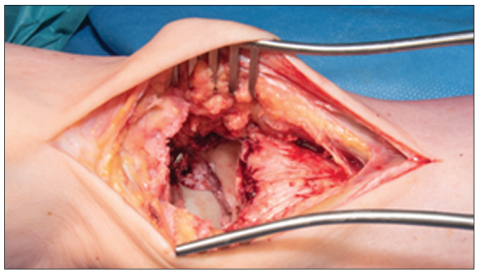

Fig. 6

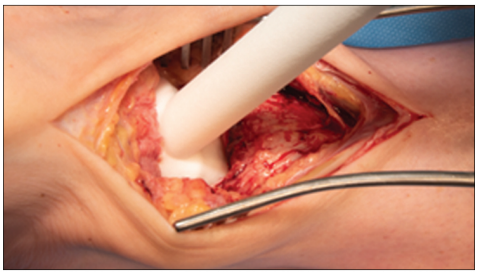

Fig. 7

ArthroZheal® is an autologous, biocompatible, bioactive, platelet-rich fibrin (PRF) matrix which promotes and accelerates the regeneration of tissue such as cartilage, meniscus, tendons, and ligaments. The sealed preparation system isolates a concentrate of thrombocytes – rich in inactivated platelet derived growth factors (PRGF) – but almost devoid of erythrocytes or leukocytes. Once the active concentrate is prepared, the contents are secured within the patented applicator, and the thrombin-free concentrate is then simultaneously applied with a pH-balancing re-coagulant as a flow-controlled, easily directed spray, which polymerises instantly upon contact with the target tissue, or synthetic prostheses, or implant. The bioactive matrix acts as a stable, long lasting medium, capable of carrying a high concentration of antibiotics to the implant and implant bed, providing prophylaxis against the formation of biofilm and localised infection. This protective effect is sustained for the period of the matrix integrity, which persists for up to 4 weeks.

ArthroZheal® also acts as an intra-operative haemostat, a stable and non-displacing polymeric matrix to potentiate tissue sealing, and a growth factor-rich reparative micro-environment which optimises healing in compromised tissue. Prior to implantation, the talus implant was coated in ArthroZheal® (6ml) and 80mg/2ml Gentamicin (figure 10). The coated implant was then inserted into the ankle following removal of the collapsed native talus, and the margins of the implant periphery and surrounding tissue were also coated with the Arthrozheal® and Gentamicin matrix, as was the external wound following closure. (figures 5 – 12).

Fig. 8

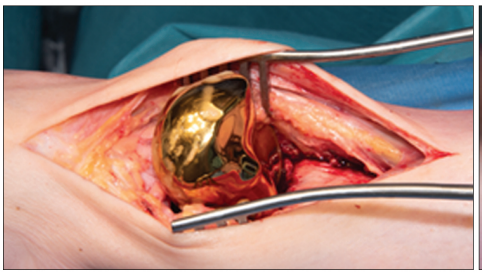

Fig. 9

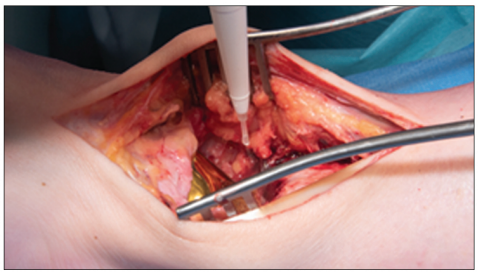

Fig. 10

Following the operation, the patient was immediately pain free and started mobilising pain free from 2 weeks post-op once the wound had healed (figure 13). The patient is now completely ambulatory, with no pain on weight bearing or walking, and is back to all activities. There were no post-operative infection-related concerns at any point.

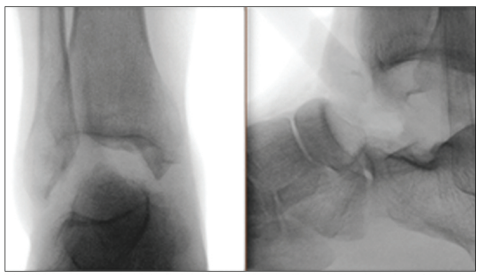

Fig. 11

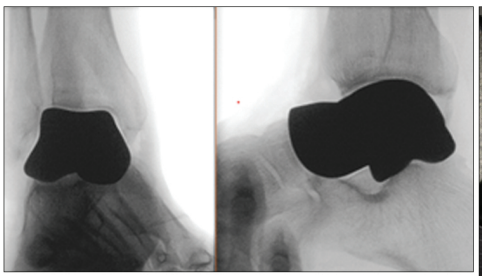

Fig. 12

Fig.13

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