A Failed Attempt of Vascularized Pedicle Graft for Post-Traumatic Navicular Avascular Necrosis in a Teenage Girl

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Purpose

Navicular avascular necrosis (AVN) is a devastating condition, which often results in fusion of the adjacent joints. It has been shown that young patients who undergo such fusion(s) will have adjacent joint pathology. The purpose of this case study is to present an attempt to re-vascularize the navicular bone with a branch of the dorsalis pedis artery.

Literature Review

The navicular has been described as the keystone to the medial longitudinal arch[1]. It's precarious blood supply, fragile soft tissue envelope, small size, and rarity of injury makes navicular fracture treatment extremely challenging[2]. The navicular connects the hindfoot to the forefoot; it is a large contributor to the "triple-joint complex" and accounts for 80% of the hindfoot motion[3,4]. There is limited literature reporting on the treatment of post-traumatic navicular avascular necrosis. The present studies mainly advocate for talonavicular-cuneiform arthrodesis and report good outcomes[5], but there is no gold standard surgical technique (Figure 5). Holm et al.[6] in 2012, reported good success with the use of a medial femoral condyle vascular bone flap in combination with medial column arthrodesis for navicular AVN. As opposed to performing a vascularized free flap, local pedicle flaps have been described. A cadaveric study was performed to characterize extraosseous vascular anatomy to the foot, in addition to describing four new rotational pedicle bone grafts[7]. Twenty cadaveric lower extremities were examined. In all 20 specimens the distal lateral tarsal artery was present.

It originated from the dorsalis pedis artery and passed anterolaterally to the dorsomedial aspect of the mid-segment of the lateral cuneiform, supplying an average of seven nutrient arteries (range 2-11). Gilbert et al.[7] described a case of harvesting this distal lateral tarsal artery and rotating it to the nonunion site of a navicular in a 47 year old woman. (Figure 2).

Figure 1 – SPECT CT

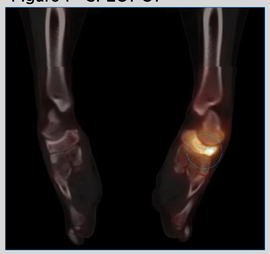


Figure 2 – Distal Lateral Tarsal Artery Vascularized Pedicle Graft

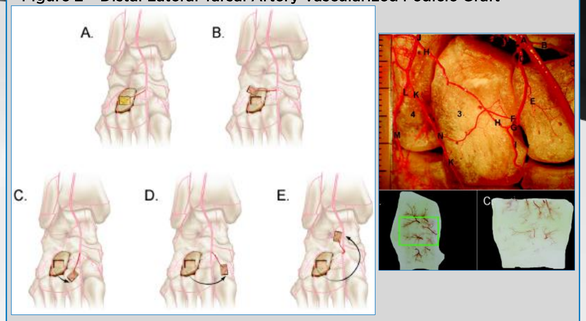
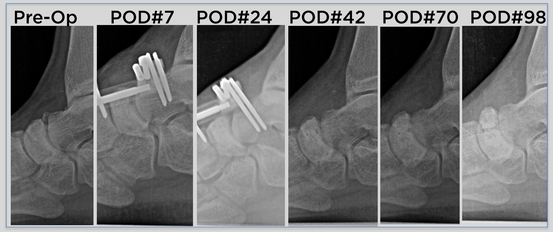


Figure 3 – Radiographic Progression of Sclerosis



Case Study

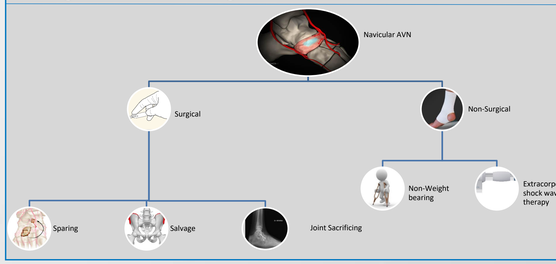
Patient is a 17 year old active female who sustained a non-displaced navicular fracture while playing rugby. MRI showed fracture of the lateral 1/3 of the navicular with subchondral bone defects. Patient was placed NWB for extended period yet continued to have pain. A CT scan confirmed fracture in the junction of the central and lateral 1/3 of the navicular as well as an osteochondral fragments and osteochondral depressive fractures. Decision was made to perform fluoroscopic guided injection of highly porous calcium phosphate to the subcortical fracture and placement of mini-rail external fixator. Subsequent sclerosis of fragmentation of the navicular bone was noted over 100 days post procedure (Figure 3). A SPECT CT scan showed avascular necrosis and subchondral collapse. In an effort to avoid arthrodesis a vascularized pedicle graft was performed to re-vascularize the avascular bone (Figure 1).

Procedure

The dorsalis pedis artery was identified using Doppler ultrasound and an incision was placed over the midfoot. The branches of the dorsalis pedis artery were identified. The distal lateral tarsal artery was traced to the lateral cuneiform. The corticoperiosteal graft was harvested. Attention was then directed to the navicular. A window, corresponding to the size of the corticoperiosteal graft, was created to the lateral aspect of this bone. A core decompression was then performed. The graft was then rotated to the recipient site in the navicular. The tourniquet was released and showed unobstructed arterial flow from the graft (Figure 4).

Figure 4 – Intra-Operative Photos

Figure 5 – Treatment Algorithm



Analysis & Discussion

The tenants to successful surgical treatment of navicular fracture are: careful planning of approach, indirect reduction technique, and biologic fixation[3]. We would add an additional tenant of adequate blood supply. In contrast to Holm et al.'s technique of a medial femoral condyle flap, a local vascularized pedicle graft was attempted due to the reduced surgical site co-morbidity[6]. In 2004, Gilbert et al.[7] described four local identifiable rotational vascularized pedicle grafts in the foot and ankle. This case highlights the consistent and easily identifiable branches of the dorsalis pedis artery which can be used for vascularized pedicle graft. This may be a viable treatment option if AVN is identified early on. Unfortunately, this patient went on to subsequent collapse and was converted to a talonavicular-cuneiform arthrodesis (Figure 6).

Figure 6 – Arthrodesis

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