Orthoplastics Tips and Tricks: Bilateral Navicular Osteonecrosis Treated with Medial Femoral Condyle Vascularized Autograft

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Abstract

A 17-year-old male with a history of chronic bilateral navicular osteonecrosis with fragmentation was treated with staged bilateral open reduction and internal fixation of tarsal navicular with debridement of necrotic bone and insertion of ipsilateral medial femoral condyle vascularized bone grafting. The patient progressed to full painless weight bearing on each extremity by four months post operatively. This patient's atypical presentation of a rare disease was well-treated with the application of orthoplastic tools and principles to promote return of function and avoidance of early arthrodesis procedure.

Figure 1. Early diagnostic bilateral foot weight-bearing x-rays, 18 months pre-op.

Case

A 17-year-old male with a history of bilateral Kohler's disease with 4 years of mild bilateral foot pain (Figure 1) presented to outpatient clinic with a 5-day history of severe right foot pain that began after an attempted acrobatic maneuver. Radiographs demonstrated a chronic appearing fracture of the right tarsal navicular with evidence of osteonecrosis of his navicular. (Figure 2) The prognosis, treatment, and challenge of Kohler's disease will be discussed later.

In order to address the patient's acute issue while minimizing the potential for failure of intervention it was recommended that patient undergo open reduction and internal fixation of his right tarsal navicular with debridement of necrotic bone with insertion of a medial femoral condyle vascularized bone graft.

Intraoperatively, the patient was induced under general anesthesia with epidural block. The right lower extremity was prepped and a tourniquet was applied. Incision was made over the dorsomedial aspect of the talonavicular joint with creation of a talonavicular dorsal capsulotomy. Exposure of the non-union revealed a transverse fracture in the axial plane with a smaller dorsal fragment and larger plantar fragment. On visualization, the dorsal fragment appeared well-vascularized in contrast to the avascular-appearing plantar fragment. A trough was created in the inferomedial pole of the navicular extending 3/4 of the way to the lateral pole, leaving 4 mm of bone distally and proximally at the joint surfaces. A free-floating

Figure 2. Preoperative x-rays and sagittal CT of patient's right foot.

devascularized navicular bone fragment was removed from the joint through a dorsal lateral incision and capsulotomy.

Vascularized medial femoral condyle bone graft with bone block measuring 1.2 cm on a side with periosteal sleeve was harvested from ipsilateral knee. Graft was isolated on a 10 cm pedicle from the superficial femoral artery and vein (Figure 3). Anterior tibial artery and vena comitans were identified and prepped as recipient vessels for the vascularized bone graft (Figure 4). Tourniquet was released and graft perfusion was verified prior to pedicle division.

The graft was then tailored to be inserted into the trough prepared in the navicular. The bone block was secured to the navicular with 2 screws and supplemental k-wire. The cortical surface and pedicle were positioned medially (Figure 5). End-to-end anastomosis to the anterior tibial artery was performed. There was immediate venous return upon arterial connection. Couplers were utilized for venous anastomosis to vena comitantes. The wounds were copiously irrigated, closed, and a posterior splint was applied. Post operatively, doppler confirmed there was excellent arterial signal going across the dorsum of the foot to the level of the cortical cancellous bone block.

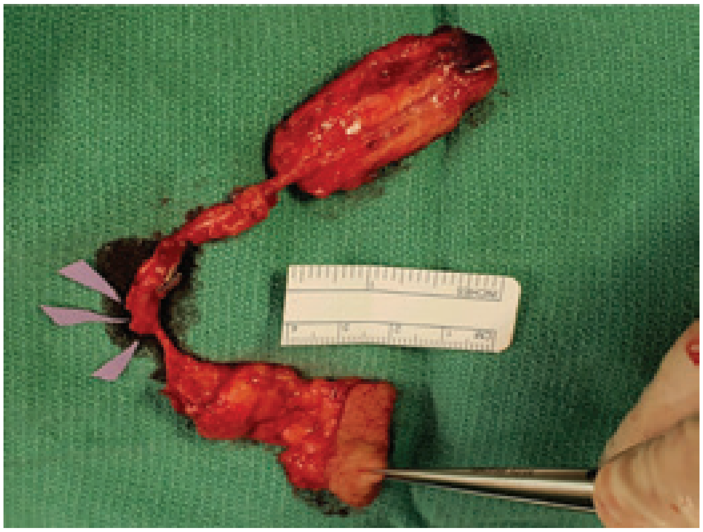

Figure 3. Prepared medial femoral condyle vascularized bone graft.

Figure 4. Intraoperative image demonstrating surgical incision and prepared recipient vessels.

Figure 5. Postoperative right foot x-rays.

Following the procedure, patient was admitted to the ICU for monitoring. vascular checks were performed every hour by nursing and every 2 hours by orthopedic house staff for the first 24 hours after surgery. Monitoring was weaned and patient was transferred to the floor. Patient was discharged without acute events on post op day three. Upon discharge, instructions were given to remain non-weight bearing on the right lower extremity and to avoid dangling the affected limb for the first 3 weeks after surgery. Sutures were removed 3 weeks post op and a short leg cast was placed. At this point the patient was allowed to dangle 56 minutes out of an hour, but was still maintained non weight bearing. Weight bearing on the right foot was sequentially advanced to partial weight bearing in a CAM boot and crutches (25% at 6 weeks post op and 50% at 9 weeks post op). At 12 weeks post op, CAM boot and crutches were weaned 1 hour per day every 3 days with physical therapy for foot and ankle strengthening. The patient ultimately progressed to full weight bearing without pain or complication by 4 months post op.

Following recovery from right foot intervention, the patient elected to undergo operative management to address chronic pain of his left foot. As described previously, patient also had a history of AVN with fragmentation and non-union of his left navicular (Figure 6). Patient underwent open reduction and internal fixation of his left navicular with debridement of necrotic bone and insertion of ipsilateral medial femoral condyle vascularized bone graft. Procedure was conducted in the same fashion as the contralateral side without significant complication (Figure 7). Postoperative management as planned to progress on the same protocol as right side. At the time of publication, the patient is 4 months post op from left-sided procedure and 10 months post op from the right-sided procedure.

Discussion

Regardless of the etiology or location, osteonecrosis has numerous therapeutic challenges.[5,13] Osteonecrosis has a large variability in presentation ranging from pain and deformity leading to permanent disability, as in avascular necrosis of the femoral head, to spontaneous resolution without lasting complication, as is common in Kohler's disease of the tarsal navicular.[3] This wide range of presentations and outcomes independent of management makes clinical decision making challenging when dealing with a case of osteonecrosis. Clinicians aim to provide the best possible outcome while avoiding unnecessary procedures. Since osteonecrosis may resolve spontaneously or progress to cause permanent disability it poses a situation where a physician may initially be reluctant to intervene. However, in hesitating to intervene early, one may miss an opportunity to prevent progression. Successful management of these patients involves identifying high risk fractures and patients and intervening on these early and aggressively.[2]

Figure 6. Preoperative left foot x-rays.

Figure 7. Postoperative left foot x-rays.

Osteonecrosis of the Navicular has multiple described causes. Kohler's disease is an idiopathic condition which occurs spontaneously in young children and has an excellent prognosis. The condition is self-limited without long-term sequelae, although recent evidence has shown that immobilization and non-weight bearing can significantly shorten the duration of symptoms.[3]

Müeller-Weiss syndrome is also an idiopathic osteonecrosis of the navicular, which presents similarly to Kohler's disease, but occurs predominantly in middle-aged adults. Müeller-Weiss syndrome has a much more ominous prognosis and can cause progressive degeneration and fragmentation of the navicular leading to foot pain and deformity.[4,10,11,12] There have been reports of early intervention in Müeller-Weiss syndrome halting or reversing disease progression. Early interventions include drilling, decompression and bone grafting, or vascularized osseous tissue grafting of the navicular.[6,7,9] Ultimately, the goal of these interventions is to re-establish blood flow to the avascular portion of the navicular and promote reconstitution of healthy osseous architecture within the tarsal navicular.

The patient presented does not fit neatly into any of the described or well understood causes of navicular osteonecrosis. His age is consistent with a diagnosis of bilateral tarsal navicular Kohler's disease; however, this disease is almost always self-limited and does not result in permanent fragmentation, deformity, or necrosis of the navicular.[5] The patient's morbidity supports a diagnosis of Mueller-Weiss syndrome, however this is not known to affect pediatric populations.[4,10]

The patient's acute on chronic navicular injury challenged conventional treatment as simple immobilization of extremity or fixation of his fracture would likely result in non-union due to the altered metabolism of his avascular navicular.[1,2] To further complicate the situation, the patient also suffered an acute unilateral injury that lead to his presentation. Current practice standard for acute management of tarsal injuries is generally conservative, however the unique situation made traditional therapy likely to fail as it would not address his underlying condition.[8,1] In our patient, the dual therapeutic goals of healing a fracture non-union in conjunction with intervention on navicular osteonecrosis necessitated more aggressive intervention. Vascularized bone grafting was utilized to optimize the biological atmosphere for fracture healing as well as replace necrotic bone with healthy biologically active bone to promote appropriate remodeling.

A case such as this presents situations where the literature fails to provide evidence-based management guidelines. Instead, a surgeon must combine and appropriately apply basic orthopedic principals, medical knowledge of biology, and advanced surgical techniques to create solutions that provide patients with a chance of an excellent outcome.

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