1. Blood Supply

Angiosomes are 3-dimensional blocks of tissue that are fed by source arteries. There are six angiosomes of the foot and ankle originating from the three main arteries and their branches. The 3 branches of the posterior tibial artery each supply distinct portions of the plantar foot. The 2 branches of the peroneal artery supply the anterolateral portion of the ankle and rear foot. The anterior tibial artery supplies the anterior ankle, and its continuation, the dorsalis pedis artery, supplies the dorsum of the foot. Blood flow to the foot and ankle is redundant because it is an end organ, the 3 major arteries feeding the foot have multiple arterial-arterial connections and arterial-venous conduits known as ‘Choke Vessels’ that allow alternative routes of blood flow to develop if the direct route is disrupted or compromised.

Adjacent angiosomes are bordered by choke vessels, which link neighboring angiosomes to one another and demarcate the border of each angiosomes. In addition, these choke vessels are important safety conduits that allow a given angiosomes to provide blood flow to an adjacent angiosomes. Occluding or interrupting one source artery surgically manipulates the system so that blood will flow through the neighboring choke vessels. This is an anatomic explanation for the “delay phenomenon”, as optimal patency of the choke vessels can take hours or days to evolve. This process is delayed in smokers and patients with systemic diseases such as diabetes. While the choke vessels provide an indirect connection among angiosomes, there are also direct arterial-arterial connections that allow blood flow to immediately bypass local obstructions in the vascular tree. Having said this, dissections made along the boundaries of the angiosomes are preferred because the microscopic flow to the edges of the wound is antegrade, originating from the source vessel on either side of the incision line. Blood flow to the edges of the dissection is immediate as it does not rely on retrograde flow, arterial-arterial connections or opening of the choke vessels.

In the hindfoot there are 3 angiosomes: (i) anterior tibial angiosomes which is bordered by the anterior aspect of the medial malleolus and the anterior ankle syndesmosis, (ii) peroneal artery angiosomes which is bordered by the anterior ankle syndesmosis and the midline of the Achilles tendon (mdi-calf), and (ii) posterior tibial artery angiosomes which is bordered by the anterior aspect of the medial malleolus and the midline of the Achilles tendon (mid-calf).

A midline posterior incision is between the peroneal and posterior tibial artery angiosomes. I have been using a direct midline incision for posterior approaches to the Achilles tendon, ankle and subtalar joint for the past 10 years with minimal wound healing difficulties and/or infections. Basic principles of wound closure need to be followed, including good hemostasis, layered closure and minimal tension on the wound edges.
Figure 1 – A midline Posterior Incision is at the border between the Posterior Tibial artery and Peroneal artery angiosomes. The microscopic blood flow to the edges of the incision and underlying dissection is antegrade allowing for optimal oxygenation of the tissues and wound healing.
2. **Wound closure**

The posterior approach to the ankle and subtalar joint has the advantage of good and immediate coverage of the fusion site with the well vascularized muscle belly of the Flexor Hallucis Longus (FHL). As the surgical video demonstrates, at the end of the procedure, the muscle belly of the FHL can be lateralized by sewing it to the peronal tendon sheath. This allows for immediate coverage of the fusion site, covering the area with well vascularized muscle bed allowing neovascularization to begin. This is an important physiologic response that helps in preventing infection and accelerating joint fusion. It also helps to cover the hardware and prevents prominence of screw heads and plates that often necessitate hardware removal when subcutaneous areas such medial, anterior or lateral plates are used.

3. **Joint preparation**

As the surgical video demonstrated good exposure of the ankle and subtalar joint is possible from the posterior approach. Access to the medial and lateral aspects of the joints is available as the approach is midline and the malleoli do not get in the way. The distal aspects of the fibular and medial malleolus are accessible, resection of these prominences are often necessary to allow for good compression at the ankle joint level and optimal correction of any varus / valgus or rotational deformities.

The tibial is also accessible - the author has performed simultaneous hindfoot fusions with tibial osteotomies for deformity correction.

4. **Access to the midfoot**

As the surgical video demonstrates, access to the talonavicular joint (TNJ) and lateral side of the midfoot is possible simply by flexing the knee. Preparation of the TNJ is easily performed with a plantar medial surgical approach. Fixation of the TNJ can be performed through this incision or by using 4.5 / 6.5 partially threaded cannulated screws through the talar holes of the posterior TTC plate.

5. **Surgical tips**

In cases where deformity correction is necessary appropriate joint debridement, soft tissue releases and malleolar correction can be performed through the posterior approach. After these steps have been taken that hindfoot / midfoot are reduced into a plantigrade position
and then temporarily stabilized with percutaneous K-wires through the calcaneus, talus and tibia. Once the desired position has been attained and stabilized with K-wires, then bone grafting and plating are easily performed. Prior to compressing the fusion construct the K-wires are removed. K-wires from the 4.5, 6.5 and 7.0mm systems can be used and compression screws can be added to augment the posterior plate and screws. The author feels that a posterior plate offers an improved opportunity for good and secure fixation into the calcaneus and good compression across the subtalar and ankle joints, particularly if the plate is augmented with single compression screws prior to final application of the posterior plate and screws.

Reference