Angiosomes of the Foot

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- Plastic Surgeon
- Melbourne, Australia
- Defined angiosome
Angiosomes

- 3D blocks of tissue
  - Fed by “source” arteries
  - Numerous direct arterial arterial connections
  - “Choke vessels” between neighboring angiosomes
- 40 angiosomes in the body
Foot and Ankle Angiosome

- 6 distinct angiosomes
- End organ
- Plan incisions
- Plan flaps
- Predict healing
- Plan bypass
Vascular Anatomy

- 3 vessels in the leg
  - Anterior Tibial Artery
    - Dorsalis Pedis Artery
  - Peroneal Artery
    - Anterior Perforating Branch
    - Lateral Calcaneal Branch
  - Posterior Tibial
    - Medial Plantar Artery
    - Lateral Plantar Artery
    - Calcaneal Branch
The Lower-Extremity Allen Test

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ABSTRACT

The Allen test is used to diagnose the relative contribution of the ulnar and radial arteries to each hand. We modified this test to investigate the relative vascular contributions to distal perfusion of the lower extremity. With the patient supine, a handheld Doppler is used to locate the first dorsal metatarsal artery. The posterior tibial artery (PT) and dorsalis pedis artery (DP) pulses are compressed. A persistent signal indicates collateral flow through the peroneal artery (PA). Sequential decompression is then used to evaluate the relative contribution of the PT and DP to distal circulation. We report a case in which angiography failed to predict reliance on the PT. In this case, performance of the lower-extremity Allen test (LEAT) led to an alternative recipient vessel choice. The LEAT is simple to perform and provides a valuable adjunct to angiographic data.

KEYWORDS: Lower-extremity reconstruction, Allen test, vascular exam, arterial supply
Angiosomes of the Foot and Ankle and Clinical Implications for Limb Salvage: Reconstruction, Incisions, and Revascularization

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Background: Ian Taylor introduced the angiosome concept, separating the body into distinct three-dimensional blocks of tissue fed by source arteries. Understanding the angiosomes of the foot and ankle and the interaction among their source arteries is clinically useful in surgery of the foot and ankle, especially in the presence of peripheral vascular disease.

Methods: 100 cadaver dissections of the lower extremity, arteries were injected with methacrylate in different colors and dissected. Preoperatively, each reconstructed patient’s vascular anatomy was routinely analyzed using a Doppler instrument and the results were evaluated.

Results: There are six angiosomes of the foot and ankle originating from the three main arteries and their branches to the foot and ankle. The three branches of the posterior tibial artery each supply distinct portions of the plantar foot. The two 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 the three major arteries feeding the foot have multiple arterial-arterial connections. By selectively performing a Doppler examination of these connections, it is possible to quickly map the existing vascular tree and the direction of flow.

Conclusions: Detailed knowledge of the vascular anatomy of the foot and ankle allows the plastic surgeon to plan vascularly sound reconstructions, the foot and ankle surgeon to design safe exposures of the underlying skeleton, and the vascular surgeon to choose the most effective revascularization for a given wound. (Plast. Reconstr. Surg 117 (Suppl.): 261S, 2006.)
Posterior Tibial

- Supplies the medial lower leg
- From medial tibia to the central raphe of the Achilles tendon
Posterior Tibial

- Perforators
  - Flexor digitorum longus
  - Soleus
- Recipient vessels
- Serial deep branches to deep flexors as well
Posterior Tibial

- Calcaneal branch
- Supplies the Calcaneal Angiosome
Calcaneal Angiosome

- Borders:
  - Medial and plantar heel
  - Distal boundary glabrous junction
Lateral plantar angiosome

- Lateral plantar artery:
  - Between flexor digitorum brevis and quadratus plantar muscle
  - Forms deep plantar arch
  - Direct anastomoses with dorsalis pedis
Posterior Tibial

- Flexor retinaculum
- Medial plantar branch
Medial Plantar Angiosome

- Instep
- Boundaries:
  - Posterior: Distal medial edge of the heel
  - Lateral: Midline of plantar foot
  - Distal: Proximal edge of the plantar forefoot
  - Medial: 2-3 cm above the glabrous junction
Medial Plantar Angiosome

- 2 branches
- Superficial:
  - Travels along superior border of cuneiform
  - Provides connections to AT
  - Distally it reconnects with deep branch and lateral plantar
Medial Plantar Angiosome

- 2 branches

- Deep:
  - Between abductor hallucis and flexor digitorum brevis
  - Distally it reconnects with deep branch and lateral planter
Posterior Tibial

- Flexor retinaculum
- Medial plantar branch
- Lateral plantar branch
Lateral Plantar Angiosome

Boundaries:

- Posteriorly: distal lateral edge of heel
- Medially: center of midfoot
- Distally: The entire lateral plantar foot
  - Hallux – can be in medial or lateral angiosome
- Laterally: Lateral glabrous junction
Lateral Plantar Angiosome

- Lateral plantar artery:
  - Between flexor digitorum brevis and quadratus plantar muscle
  - Forms deep plantar arch
  - Direct anastomoses with dorsalis pedis
Anterior Tibial

- Pierces Interosseus membrane
- Proximally supplies peroneus longus and brevis
- Supplies anterior compartment (tibialis anterior, extensor hallucis longus, extensor digiturom longus)
- Extensor retinaculum
- Dorsalis pedis
Anterior Tibial Angiosome

- All skin over the anterior compartment
- Fibula is the lateral border
- Dorsalis pedis = entire dorsum of the foot
Anterior Tibial

- Lateral malleolar artery
  - Joins anterior perforating branch of the peroneal
- Medial malleolar artery
  - Joins posteromedial artery of the posterior tibial
Dorsalis pedis

Connections:

- Superficial medial plantar artery (PT) on the medial side
- Calcaneal branch (peroneal) on proximolateral side
- Lateral planter (PT) distally
Dorsalis pedis: Lateral Branches

- Net like pattern
- Proximal Lateral Tarsal artery
  - Originates at the lateral tarsal neck
  - Under the extensor digitorum brevis
  - Connects to the Calcaneal branch (peroneal) on proximolateral side
- Distal Lateral Tarsal artery
Dorsalis pedis: Lateral Branches

- Arcuate artery
  - Originates at the first tarsal-metatarsal joint
  - Gives off the 2\textsuperscript{nd}, 3\textsuperscript{rd}, and 4\textsuperscript{th} dorsal metatarsal artery
Dorsalis pedis: Medial Branches

- Two medial tarsal arteries
  - Middle of the navicular bone
  - Cuneonavicular joint
- One of these joins with the superficial medial plantar (PT)
Dorsalis pedis

- Become first dorsal metatarsal artery
- Supplies:
  - First interosseus muscle and skin over it.
  - First webspace
  - Hallux and second toe
Peroneal

- Tibial peroneal trunk
- Medial to the fibula
- Posterolateral leg
Peroneal

- Supplies
  - Muscle of the deep posterior compartment (tibialis posterior, flexor hallucis, flexor digitorum longus)
  - Fibula
  - Lateral Soleus
  - Lateral Achilles tendon
  - Lower distal two-thirds of the peroneus longus and brevis
Peroneal Angiosome

- Posterolateral leg
- Medial to the fibula
- Perforators from the peroneal artery
- 3 to 5 cm intervals
Peroneal Angiosome

- Boundaries:
  - Plantar and lateral heel (Calcaneal Angiosome)
  - Extend to the proximal 5th metatarsal
  - To lateral malleolus
Peroneal

- Lateral malleolus
- Anterior perforating branch
- Calcaneal branch
Peroneal: Calcaneal Angiosome

- Privileged
  - Supplied by calcaneal branch from peroneal
  - Supplied by calcaneal branch from posterior tibial
- Dual blood flow to an area regularly traumatized with ambulation
Peroneal

- Anterior perforating branch
  - Angiosome extends over the lateral ankle
  - Joins lateral malleolar artery of anterior tibial
Vascular Anatomy/Angiosomes

- 3 vessels in the leg
- Anterior Tibial Artery
  - Dorsalis Pedis Artery
- Peroneal Artery
  - Anterior Perforating Branch
  - Lateral Calcaneal Branch
- Posterior Tibial
  - Medial Plantar Artery
  - Lateral Plantar Artery
  - Calcaneal Branch
PT Vascular Connections

- Posterior Tibial
  - Posteromedial artery - medial malleolar artery (AT)
  - Medial Plantar Artery – medial tarsal (AT)
  - Lateral Plantar Artery – First dorsal metatarsal artery (AT)
  - Calcaneal Branch – calcaneal branch (Peroneal)
AT Vascular Connections

- Anterior Tibial Artery
  - Lateral malleolar artery - anterior perforating branch (peroneal)
  - Medial malleolar artery - posteromedial artery (PT)
  - Medial Tarsal - superficial medial plantar (PT)
  - Dorsalis pedis - calcaneal branch (peroneal)
  - First dorsal metatarsal artery – lateral plantar (PT)
Peroneal Vascular Connections

- Peroneal Artery
  - Anterior Perforating Branch - lateral malleolar artery (AT)
  - Lateral Calcaneal Branch – calcaneal branch (PT), dorsalis pedis (AT)
Angiosomes

- 6 distinct angiosomes
- Multiple arterial-arterial connections
- Plan incisions
- Plan flaps
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