

Ultrasound – Deep Vein Arterialization Pre-Op Evaluation

PURPOSE:

To evaluate calf and pedal veins to determine viability for deep vein arterialization procedure in patients with Critical Limb-Threatening Ischemia (CLTI).

SCOPE:

Applies to Ultrasound Lower Extremity Vein Mapping requested to be performed as part of planning for deep vein arterialization procedure:

- UT Southwestern William P. Clements Jr. University Hospital and Clinics, Imaging Services (UTSW Radiology)

ORDERABLE:

- US VEIN MAPPING LOWER EXTREMITY PRE-SURGICAL

CHARGEABLE:

- 93971 (Unilateral Lower Extremity Vein Mapping)
- 93970 (Bilateral Lower Extremity Vein Mapping)

INDICATIONS:

- Pre-operative screening and planning for deep vein arterialization procedure
- May be referred to as DVA or LimFlow Graft

CONTRAINDICATIONS:

- No absolute contraindications

EQUIPMENT:

- Commercial duplex Doppler ultrasound system
 - Preferably a linear array transducer that allows for appropriate resolution of anatomy (frequency range of 9 MHz or greater), capable of duplex imaging. Sector or curvilinear transducers may be required for appropriate penetration in patients with edema or large body habitus
 - A hockey stick probe may be used for plantar vein evaluation

PATIENT PREPARATION:

- Patient should be placed in a supine reverse Trendelenburg position.
- Place a tourniquet at the patient's ankle to maximize vein diameter in the foot.
- Leg and/or plantar surface of foot should be kept warm to prevent vein spasm (i.e. warm pack or warm blanket).

EXAMINATION:

GENERAL GUIDELINES:

- The examination will be unilateral unless otherwise indicated.
- A complete examination includes evaluation of the entire course of the accessible portions of each vessel.
- Variations in technique must be documented.

EXAM INITIATION:

- Introduce yourself to the patient/family.
- Verify patient identity using patient name and DOB.
- Explain test.
- Obtain patient history including symptoms.
- Enter and store data page.
- Patient should be placed in a supine reverse Trendelenburg position.

TECHNICAL CONSIDERATIONS:

- Equipment gain and display settings will be optimized while imaging vessels with respect to depth, dynamic range, and focal zones.
- Proximal and distal refer to the relative distance from the attached end of the limb (proximal PTV/PTA is closer to knee, and distal is closer to foot; Prox GSV is below knee, distal is at ankle).
- **Venous Considerations**
 - Apply a tourniquet at the ankle to maximize vein diameter.
 - All vessels will be checked for patency with intermittent transducer compression.
 - Document extent of thrombus, if identified.
 - If identified, a full DVT protocol may be warranted. Contact Order Team for further instructions.
 - Document areas of wall thickening, thrombus, or large varicosities, perforators, or branches off the LPV or GSV.
 - Entire length of calf veins (PTV, Pero V, GSV, ATV) should be evaluated with compressions for DVT.
 - In the absence of thrombus (PTV, Pero V, GSV, ATV), only 1 level (at distal) needs to be documented (Trans compression cine).
 - ATV is only evaluated in occlusion or absence of the GSV.

DOCUMENTATION:

1. Venous Pre-Op DVT & Vein Mapping Evaluation

| | | |
|--|--|--|
| 1. | PTV Distal | Trans, compression cine |
| 2. | Largest of paired PTV at ankle | Trans, grayscale – AP and Trans diameter |
| 3. | Largest of paired LPV | Trans, Compression cine |
| 4. | Largest of paired LPV at Prox foot | Trans, grayscale – AP and Trans diameter |
| 5. | Largest of paired LPV at mid/Distal foot | Trans, grayscale – AP and Trans diameter |
| 6. | Pero V Distal | Trans, Compression cine |
| 7. | GSV at ankle | Trans, Compression cine |
| 8. | MMV dorsal foot | Trans, Compression cine |
| 7. | MMV at prox dorsal foot | Trans, grayscale – AP and Trans diameter |
| | MMV at mid dorsal foot | Trans, grayscale – AP and Trans diameter |
| 9. | MMV at distal dorsal foot | Trans, grayscale – AP and Trans diameter |
| *If GSV is occluded or absent, evaluate ATV's | | |
| 10. | ATV at ankle | Trans, Compression cine |
| 11. | Largest of paired ATV at ankle | Trans, grayscale – AP and Trans diameter |

PTV: Posterior Tibial Vein
 GSV: Greater Saphenous Vein
 ATV: Anterior Tibial Vein
 LPV: Lateral Plantar Vein
 MMV: Medial Marginal Vein

- Save data page(s)

PROCESSING:

- Review examination data
- Export all images to PACS
- Note any study limitations

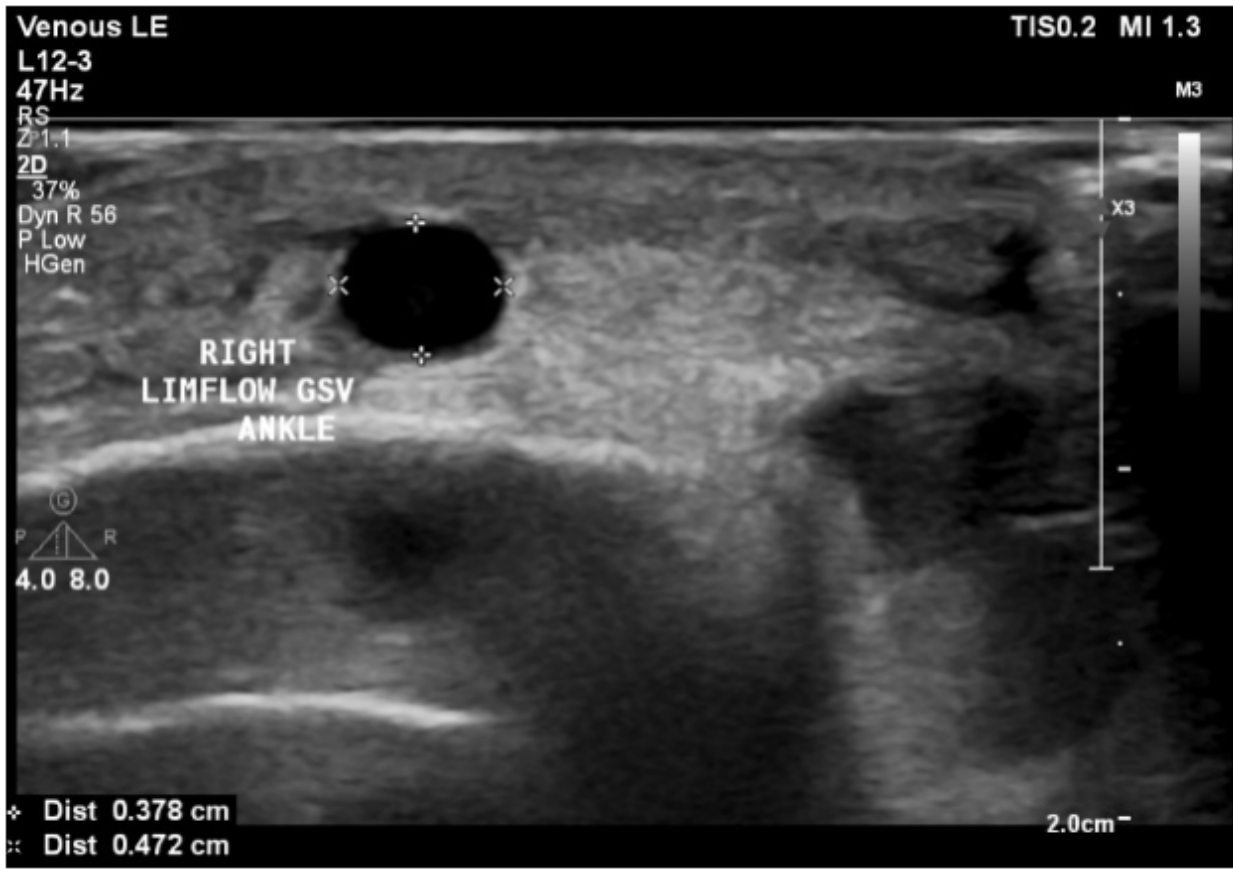
DIAGNOSTIC CRITERIA:

- Ideal LPV measurement: ≥ 3.0 mm

REFERENCES:

- Shishehbor MH, Powell RJ, Montero-Baker MF, et al. Transcatheter Arterialization of Deep Veins in Chronic Limb-Threatening Ischemia. *New England Journal of Medicine*. 2023;388(13):1171-1180. doi:<https://doi.org/10.1056/nejmoa2212754>
- N'Dandu Z, Bonilla J, Yousef GM, White CJ. Percutaneous deep vein arterialization: An emerging technique for no-option chronic limb-threatening ischemia patients. *Catheterization and Cardiovascular Interventions*. 2020;97(4):685-690. doi:<https://doi.org/10.1002/ccd.29386>
- Ho VT, Gologorsky R, Kibrik P, et al. Open, percutaneous, and hybrid deep venous arterialization technique for no-option foot salvage. *Journal of Vascular Surgery*. 2020;71(6):2152-2160. doi:<https://doi.org/10.1016/j.jvs.2019.10.085>
- Yan Q, Treffalls JA, Ferrer L, Davies MG. A Review of Current Noninvasive Imaging Surveillance Practices for Deep Venous Arterialization Procedures. *Journal for Vascular Ultrasound*. 2021;45(2):59-63. doi:<https://doi.org/10.1177/1544316721996944>
- Fitzpatrick S, Dunlap E, Nagarsheth KH. Utilization of Deep Vein Arterialization for Limb Salvage. *Journal for Vascular Ultrasound*. Published online October 6, 2023. doi:<https://doi.org/10.1177/15443167231202502>
- Clair DG, Mustapha JA, Shishehbor MH, et al. PROMISE I early feasibility study of the LimFlow System for percutaneous deep vein arterialization in no-option chronic limb-threatening ischemia 12-month results. *Journal of Vascular Surgery*. Published online May 18, 2021. doi:<https://doi.org/10.1016/j.jvs.2021.04.057>
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APPENDIX:



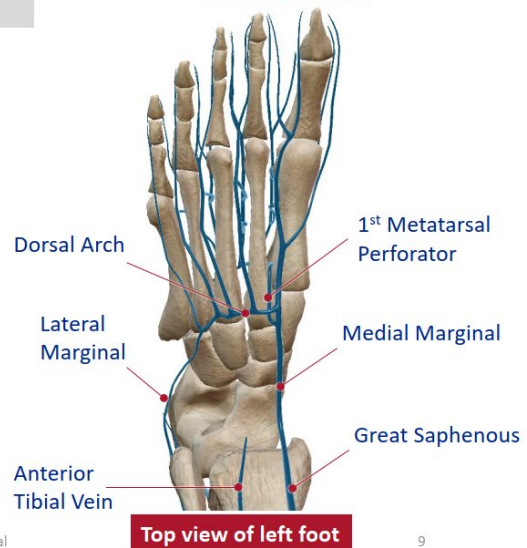
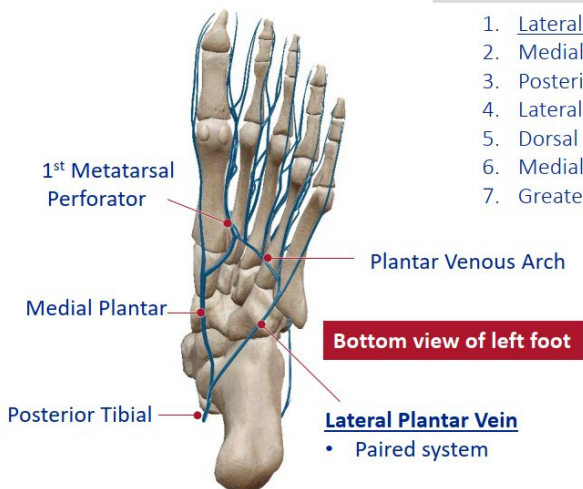
Pedal Venous Anatomy: Overview

Plantar Veins

VEINS TO KNOW

1. Lateral Plantar
2. Medial Plantar
3. Posterior Tibial
4. Lateral Marginal
5. Dorsal Venous Arch
6. Medial Marginal
7. Greater Saphenous

Dorsal Veins



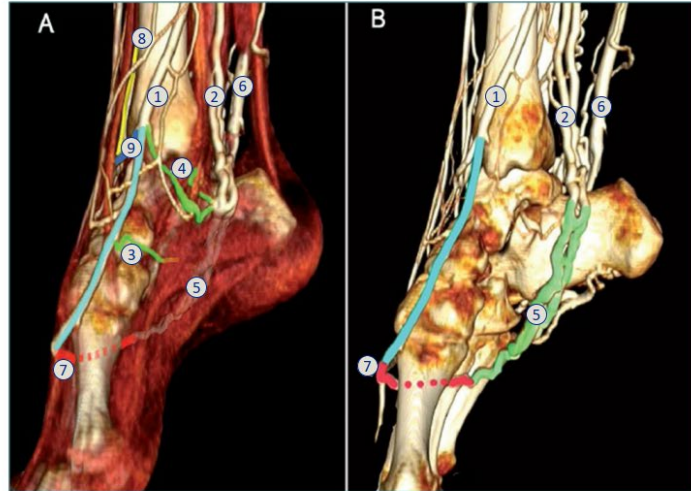
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Pedal Venous Anatomy: Arterialized Circuit

1. Great saphenous vein
2. Posterior tibial veins
3. Navicular perforator vein
4. Inframalleolar perforator vein
5. Lateral plantar veins
6. Small saphenous vein
7. Perforator vein of the first intermetatarsal space
8. Anterior tibial vein
9. Dorsal perforator to the anterior tibial vein



Uhl JF, Vuolo M, Gillot, C. Anatomy of foot and ankle perforator veins. *Phlebology*. 2017;24(2):105-112.

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CHANGE HISTORY:

| STATUS | NAME & TITLE | DATE | BRIEF SUMMARY |
|-------------------|--|-------------------|---|
| Submission | Skye Smola, US Technical Supervisor | 11/27/2023 | Submitted |
| Approval | Dr. Girish Kumar | 12/22/2023 | Approved |
| Review | | | Reviewed |
| | | | |
| Revisions | Dr. David Fetzer, Skye Smola, Kim Pong | 2/5/24 | In Review 2/20/24 |
| | Dr. Girish Kumar | 4/15/24 | Approved abbrev protocol |
| | Skye Smola | 12/11/24 | Corrected LPV diagnostic criteria to \geq to 3.0 mm |