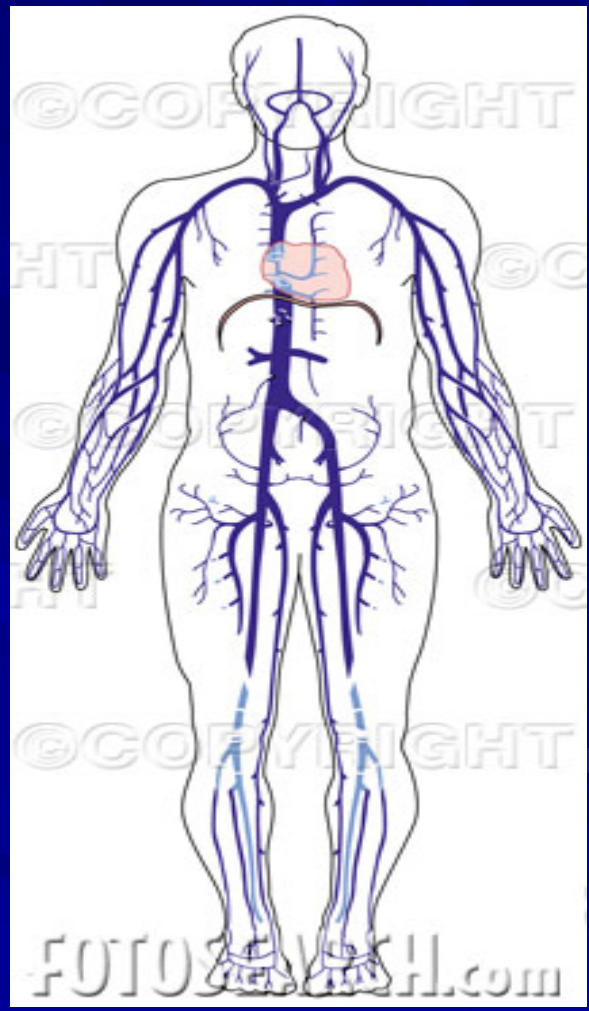
Venous Disease

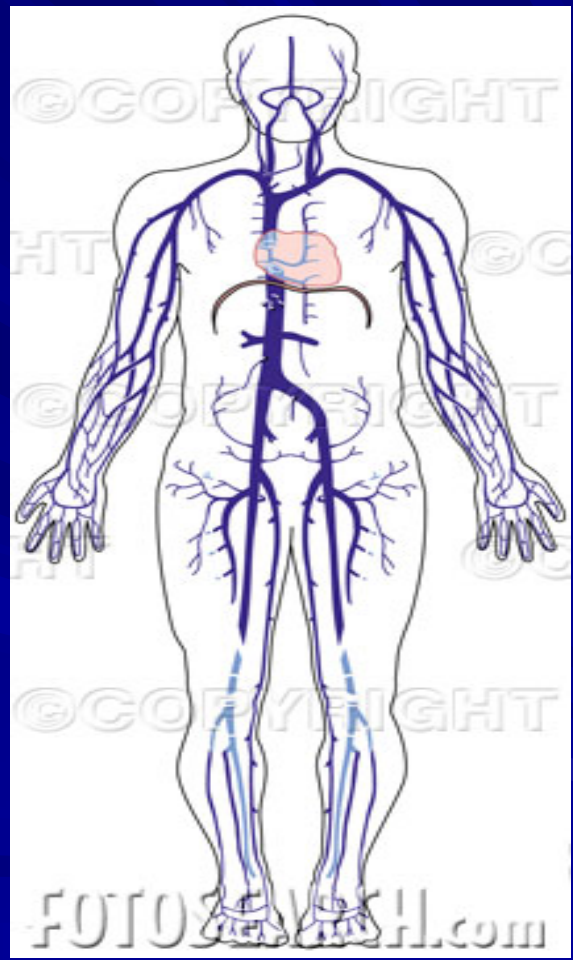
Venous System

- The peripheral venous system functions both as a reservoir to hold extra blood and as a conduit to return blood from the periphery to the heart and lungs.
- The entire cardiac output volume of 5 to 10 L/min is received into end-capillary venules for eventual delivery back to the heart and lungs.



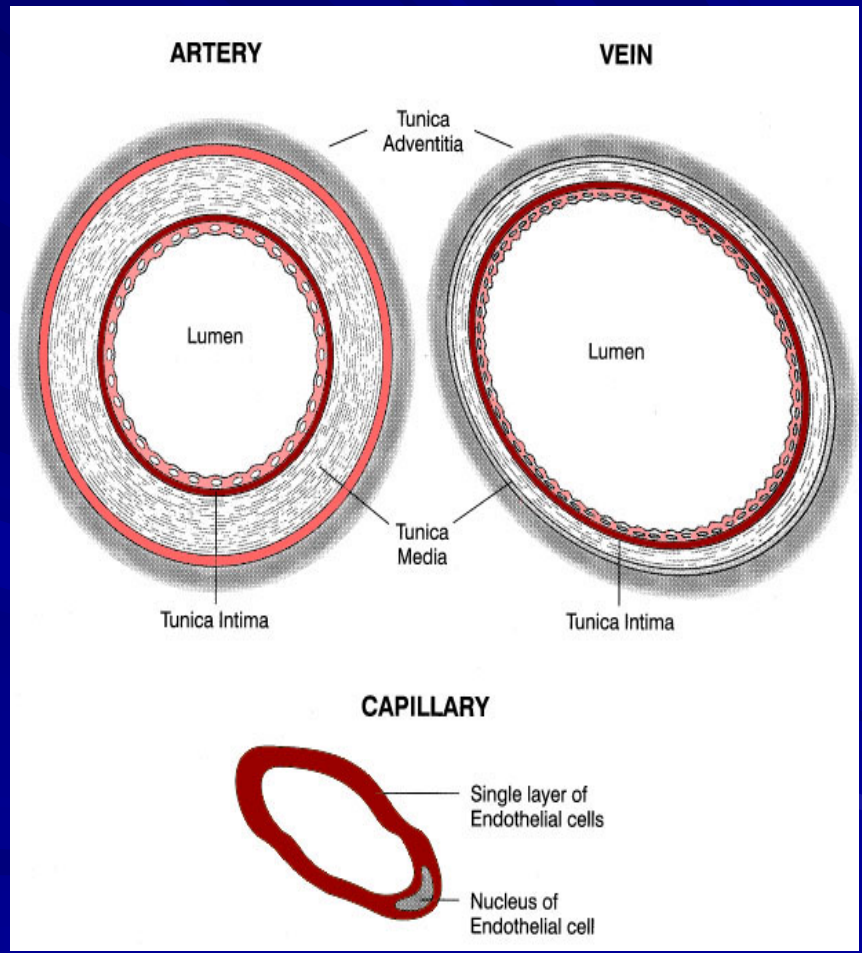
Venous System

- Primary collecting veins of the lower extremity are passive, thin-walled reservoirs that are tremendously distensible.
- The volume of blood sequestered within the venous system at any moment can vary by a factor of two or more without interfering with the normal function of the veins.
- The volume of blood in our venous system is 2 to 2 1/2 times that in the arterial system.

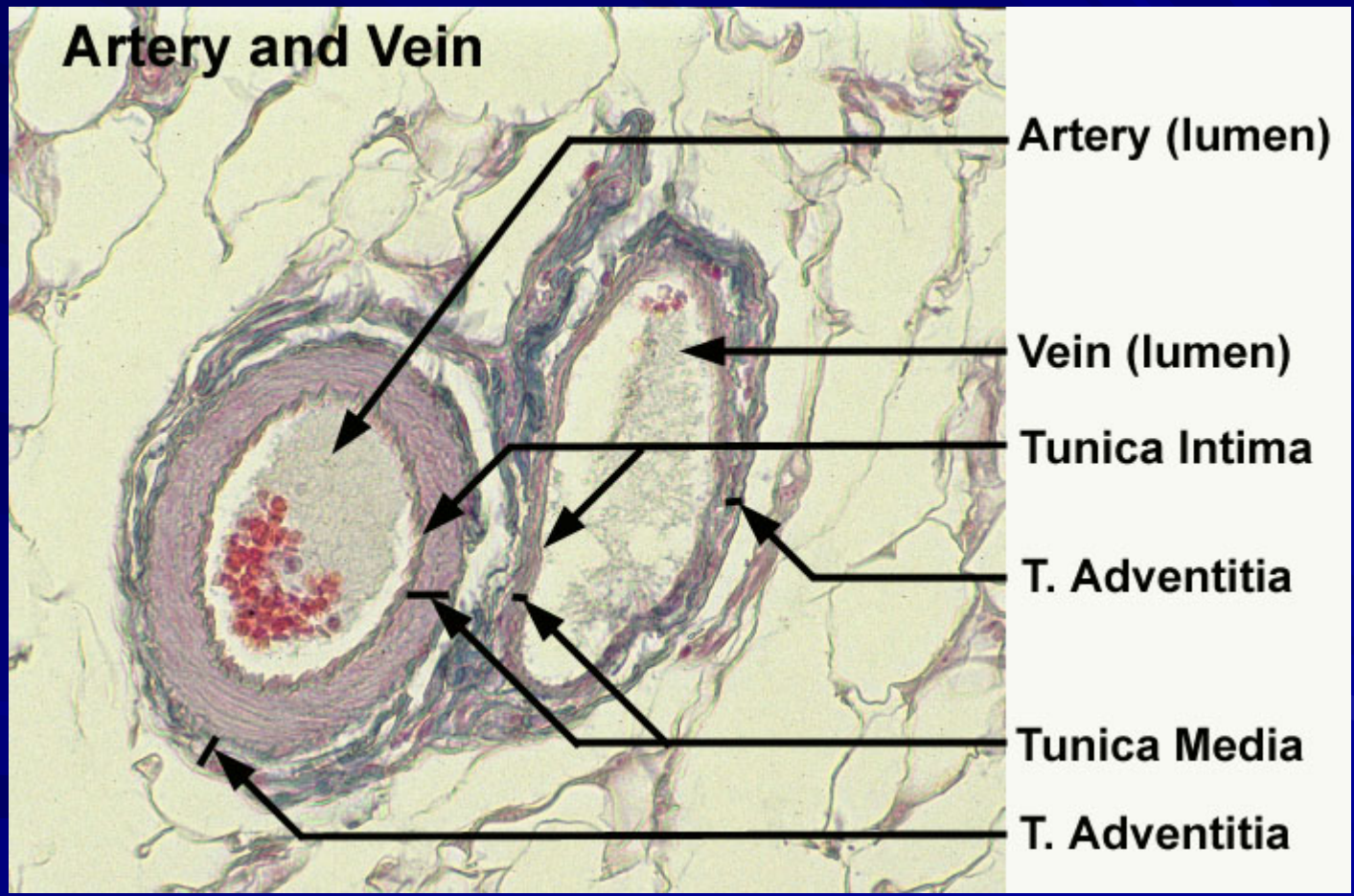


Histology

- Tunica intima – endothelial layer on basement membrane.
- Tunica media – smooth muscle and connective tissue. Smaller the vein, greater the smooth muscle.
- Tunica adventitia – contains adrenergic fibers



Histology


Artery and Vein
Artery (lumen)
Vein (lumen)
Tunica Intima
T. Adventitia
Tunica Media
T. Adventitia

Valves

- All the leg veins have delicate valves inside them, which should allow the blood to flow only upwards (towards the heart), or from the superficial veins to the deep ones through the perforating veins.
- A valve occurs every five to ten centimetres in the main superficial veins of the legs

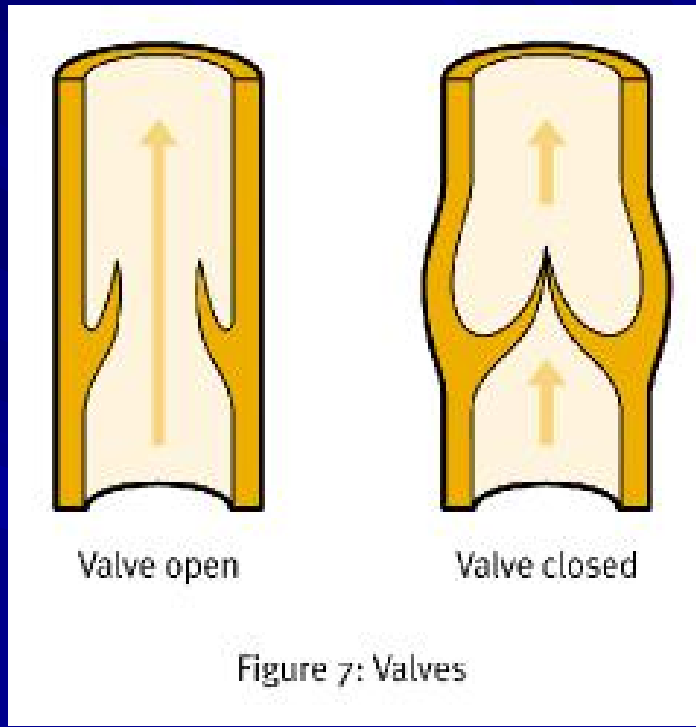
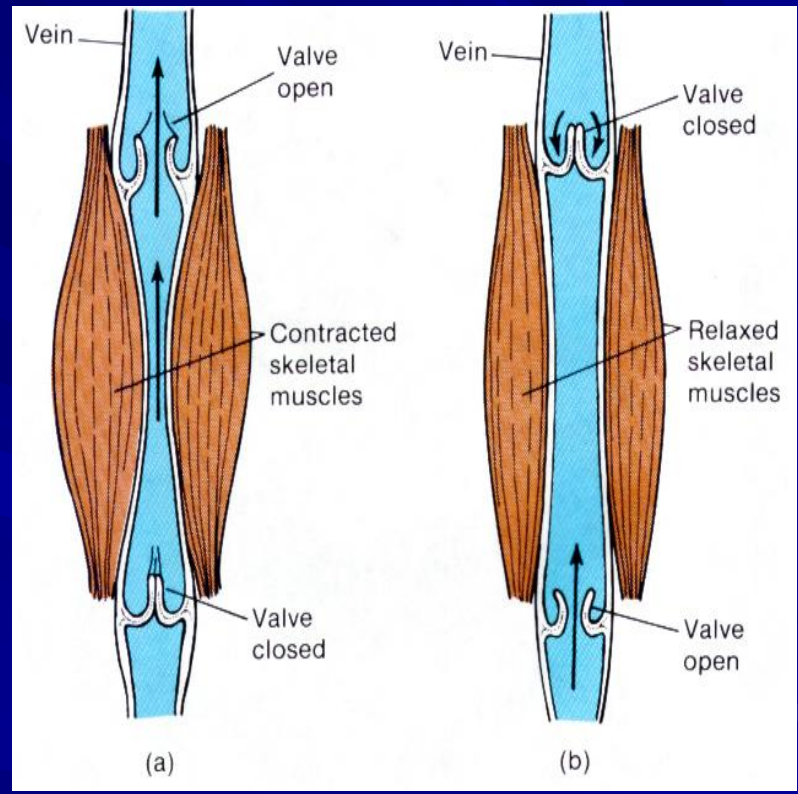


Figure 7: Valves

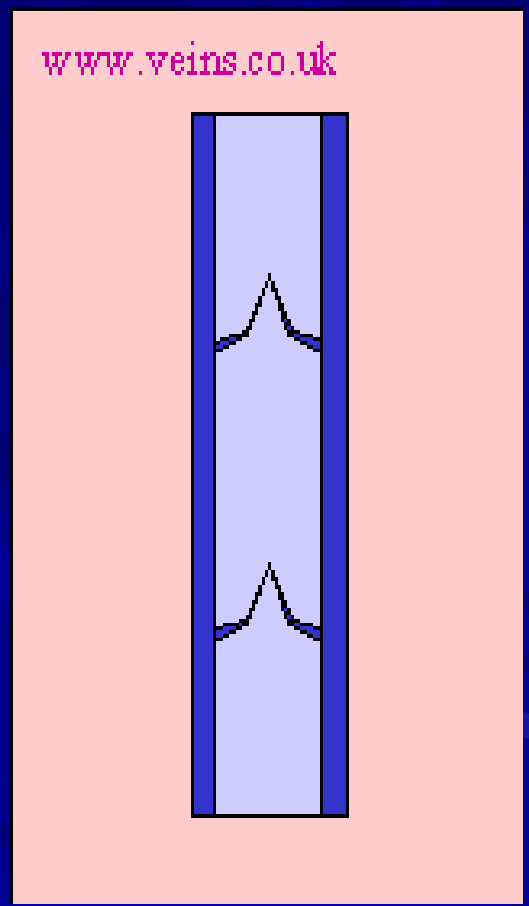
The Venous Pump

- Large muscle groups compress the deep veins when the muscles contract.
- Venous compression increases the pressure within the vein, which closes upstream valves and opens downstream valves, thereby acting as a pumping mechanism.



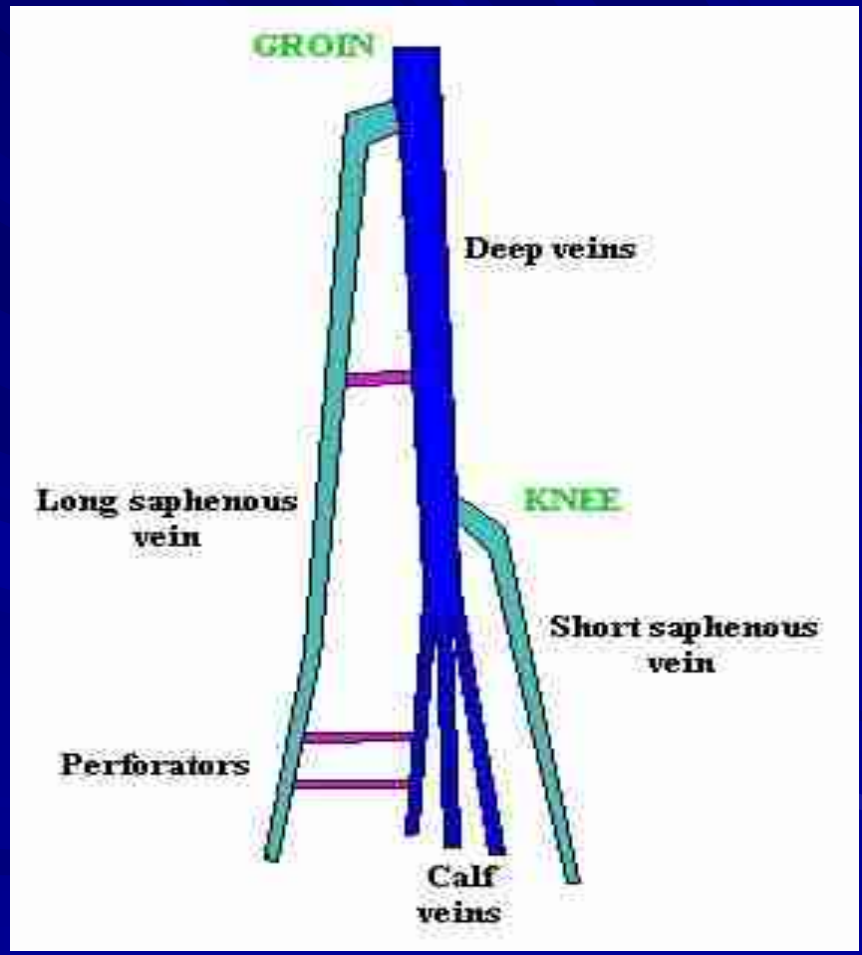
The venous pump

- During normal standing and walking, the venous pump assists venous return. As the calf muscles contract, they compress the nearby blood vessels propelling blood towards the heart.
- During muscle relaxation, the vessel once again fills with blood and the cycle is repeated during the next contraction
- The calf muscle pump can achieve pumping pressures of several hundred mm Hg before valve failure occurs.



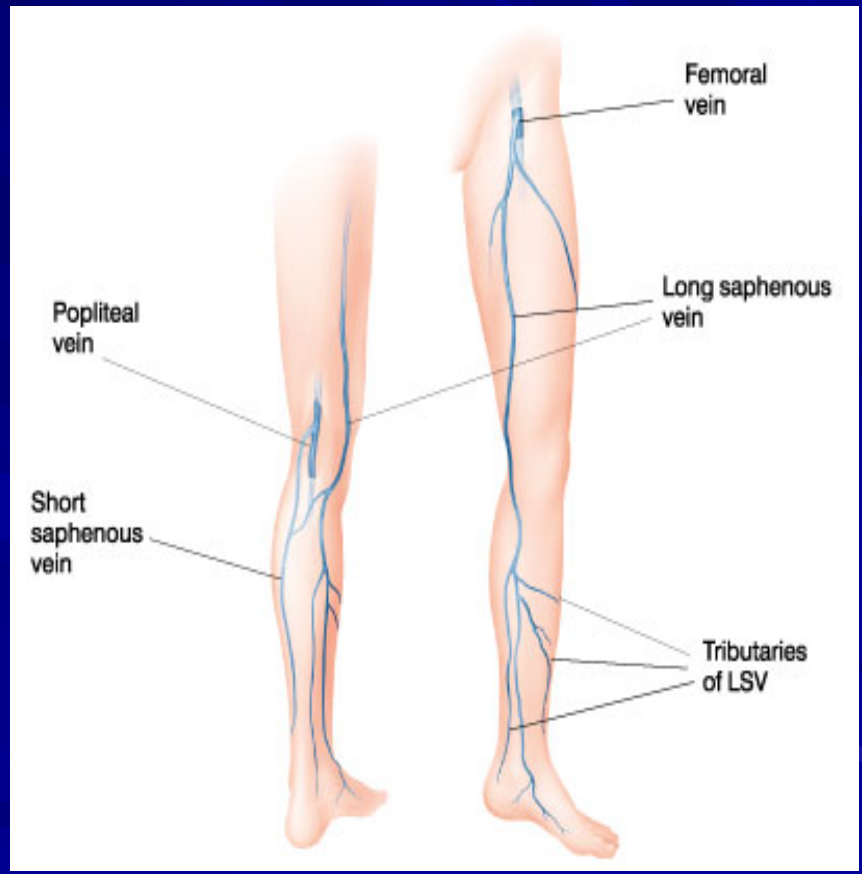
Venous System

- The deep system is the main way blood leaves the leg and returns to the heart.
- The superficial system is just under the skin and can be seen
- Varicose veins affect this system. It is not essential for draining blood from the leg



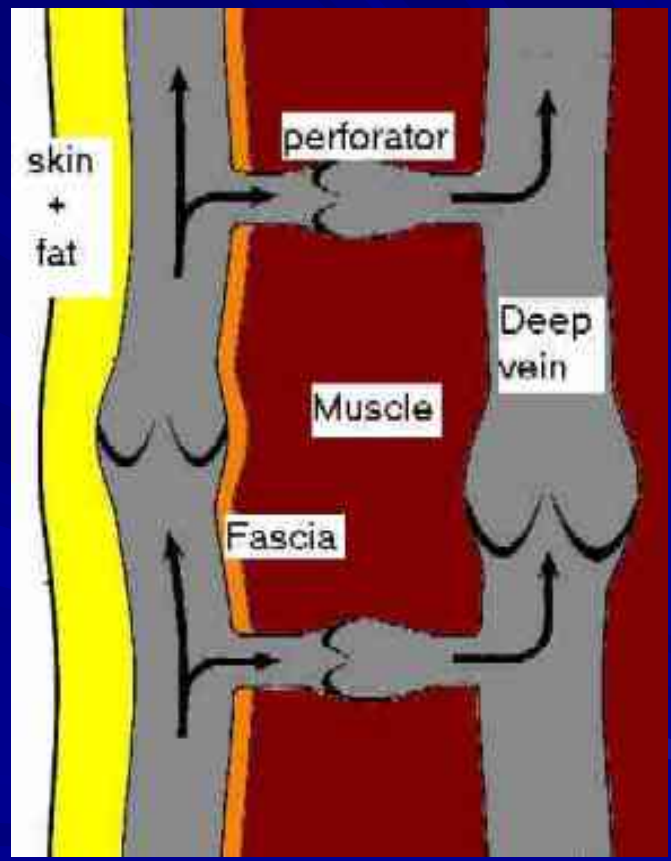
Lower Extremity

- There are essentially 2 superficial veins - the long and short 'saphenous' veins.
- The long saphenous vein runs from the inner ankle, along the inside of the leg and joins the deep veins in the groin (the 'sapheno-femoral junction').
- The short saphenous vein starts at the outer ankle and runs along the back of the calf to join the popliteal vein behind the knee ('sapheno-popliteal junction').



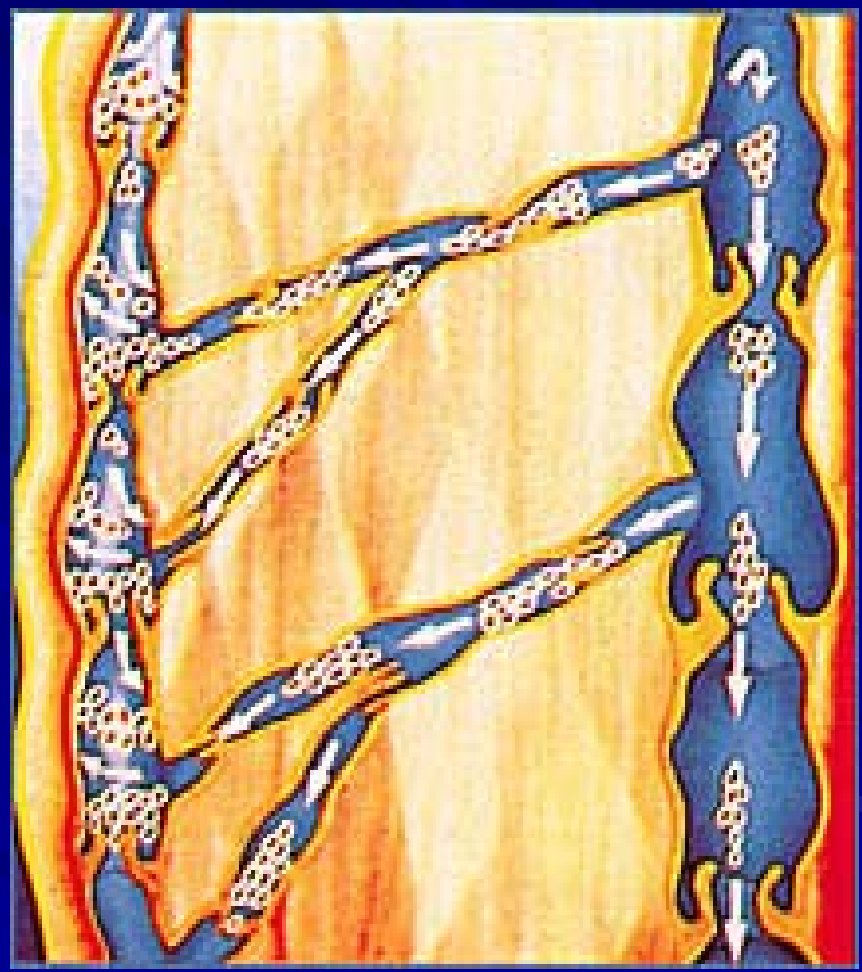
Cockett Perforators

- In addition to these junctions the deep and superficial veins are connected by small veins called 'perforators'. They are so-named because they perforate through the tough covering of the muscles (fascia).
- Perforating veins usually contain venous valves that prevent reflux of blood from the deep veins into the superficial system.



Venous Insufficieny

- REFLUX!!!
- Superficial venous incompetence is the most common form of venous disease.
- Deep, superficial, or mixed.



CEAP Classification

- An attempt to allow us to clearly describe the type of venous disease being discussed.
- “C” – Clinical findings
- “E” – Etiology
- “A” – Anatomic
- “P” – Pathophysiologic

Clinical

- C0 = no visible venous disease
- C1 = telangiectatic or reticular veins
- C2 = varicose veins
- C3 = edema
- C4 = skin changes without ulceration
- C5 = skin changes with healed ulceration
- C6 = skin changes with active ulceration

Etiologic

- E_c - congenital disease
  - present since birth

- E_p – primary disease
  - unknown cause

- E_s – secondary disease
  - known cause (post-phlebitic, trauma)

Anatomic - superficial

1. Telangiectasias or reticular veins
2. Greater saphenous vein - above the knee
3. Greater saphenous vein - below the knee
4. Lesser (short) saphenous vein
5. Nonsaphenous

Anatomic - Deep

1. Inferior vena cava
2. Common iliac
3. Internal iliac
4. External iliac
5. Pelvic: gonadal, broad ligament, etc.
6. Common femoral
7. Deep femoral
8. Superficial femoral
9. Popliteal
10. Crural: anterior tibial, posterial tibial, peroneal
11. Muscular: gastrocnemius, soleus, etc.

Anatomic - perforators

1. Thigh
2. Calf

Pathophysiologic

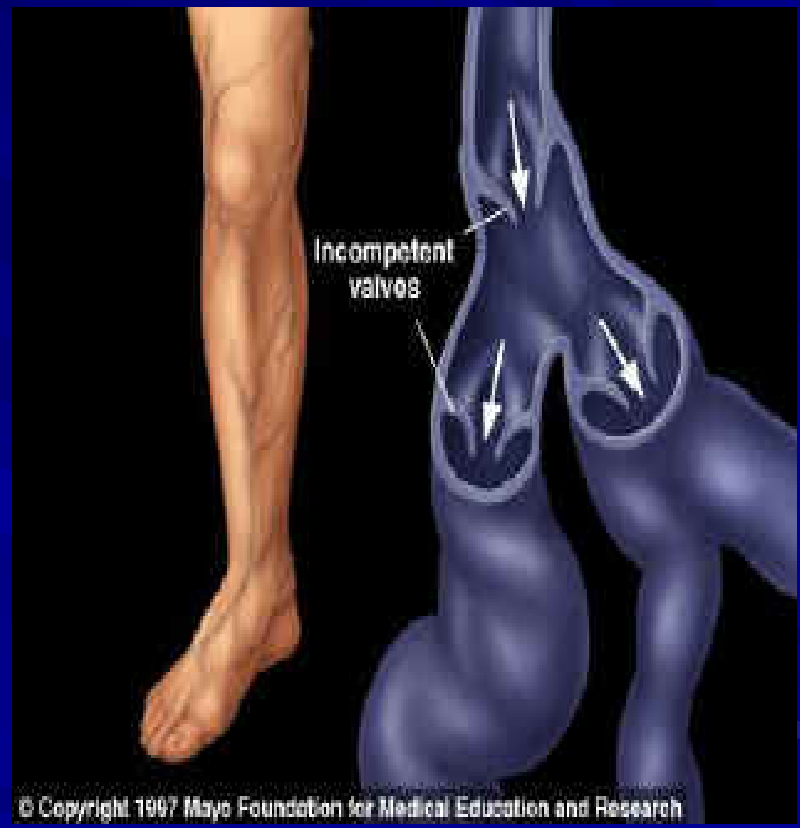
- Reflux – P_R
- Obstruction – P_O
- Reflux and obstruction - P_{RO}

Venous Insufficiency

- The long saphenous vein and its tributaries are the ones that most often form varicose veins.
- Retrograde flow through the superficial venous system occurs when venous valve no longer perform their usual function.
- Direct injury or superficial phlebitis may cause primary valve failure.

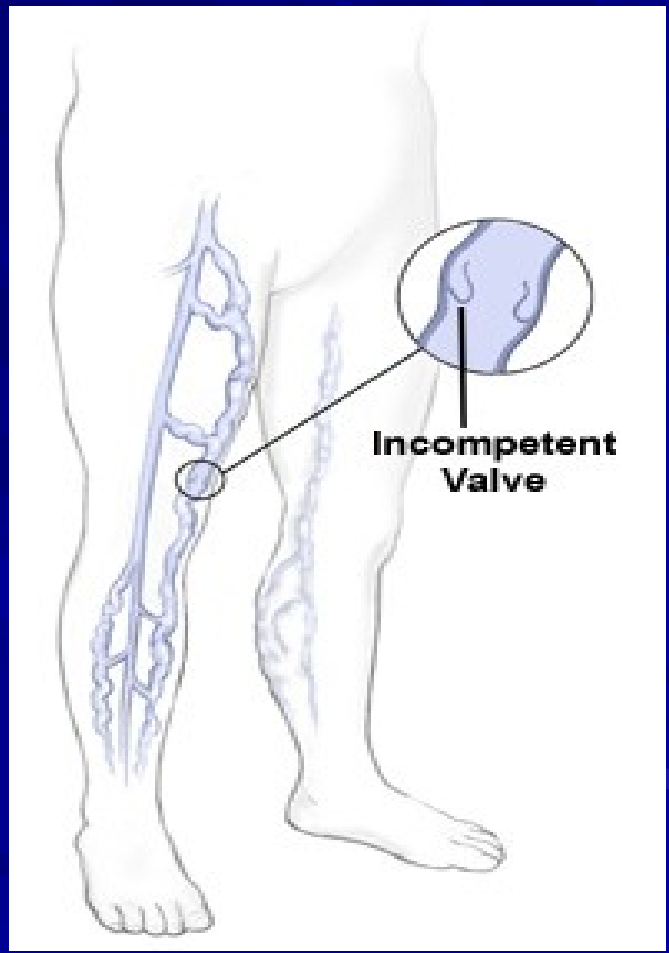
Venous Insufficiency

- Congenitally weak vein walls may dilate under normal pressures to cause secondary valve failure, or congenitally abnormal valves may be incompetent at normal superficial venous pressures.
- Normal veins and normal valves may become excessively distensible under the influence of hormones (as in pregnancy.



Venous insufficiency

- If deep vein valves fail to work effectively, the high pressure in the deep veins, is transmitted to the much weaker, unsupported superficial veins. These veins become distended and tortuous (varicose veins).
- Perforator incompetence allows the extremely high pressures generated within deep veins by the calf muscle pump to be communicated to the superficial veins



Venous Insufficiency

- Superficial venous reflux is simply the inevitable end result of the introduction of high pressures into otherwise normal superficial veins that were intended to function as a low-pressure system.
- Capillary pressure becomes increased, and fluid is forced out into the extravascular space. This can then progress onto chronic venous insufficiency

Junctional high pressures

- Failure of the primary valve at the junction between the GSV and the CFV (the SFJ), or at the junction between the SSV and PV (the SPJ).
- Vein dilatation in these cases proceeds from proximal to distal, and patients perceive that a large vein is "growing down to the leg

Perforator high-pressure

- failure of the valves of any perforating vein
- The most common sites at the canal of Hunter in the midproximal thigh (Hunterian vein) and in the proximal calf
- The primary high-pressure entry point is distal,

Venous Insufficiency

- 70% of patients can identify superficial venous disease as a familial trait.
- Female hormonal influences on the veins are profound
- Progesterone causes passive dilatation, estrogen relaxes smooth muscle and softens collagen

Symptoms

- Aching and heaviness of the legs are common complaints, particularly after standing up for a long time.
- Itching, a feeling of heat and tenderness over their veins
- Tend to be worse at the end of the day, and relieved (at least to some extent) by ‘putting your feet up’

Symptoms

- Mild eczema and itchiness of the skin – usually just above the ankle
- If neglected, the eczema can become very severe, with inflamed, red, scaly skin all around the lower leg.

Ulcers

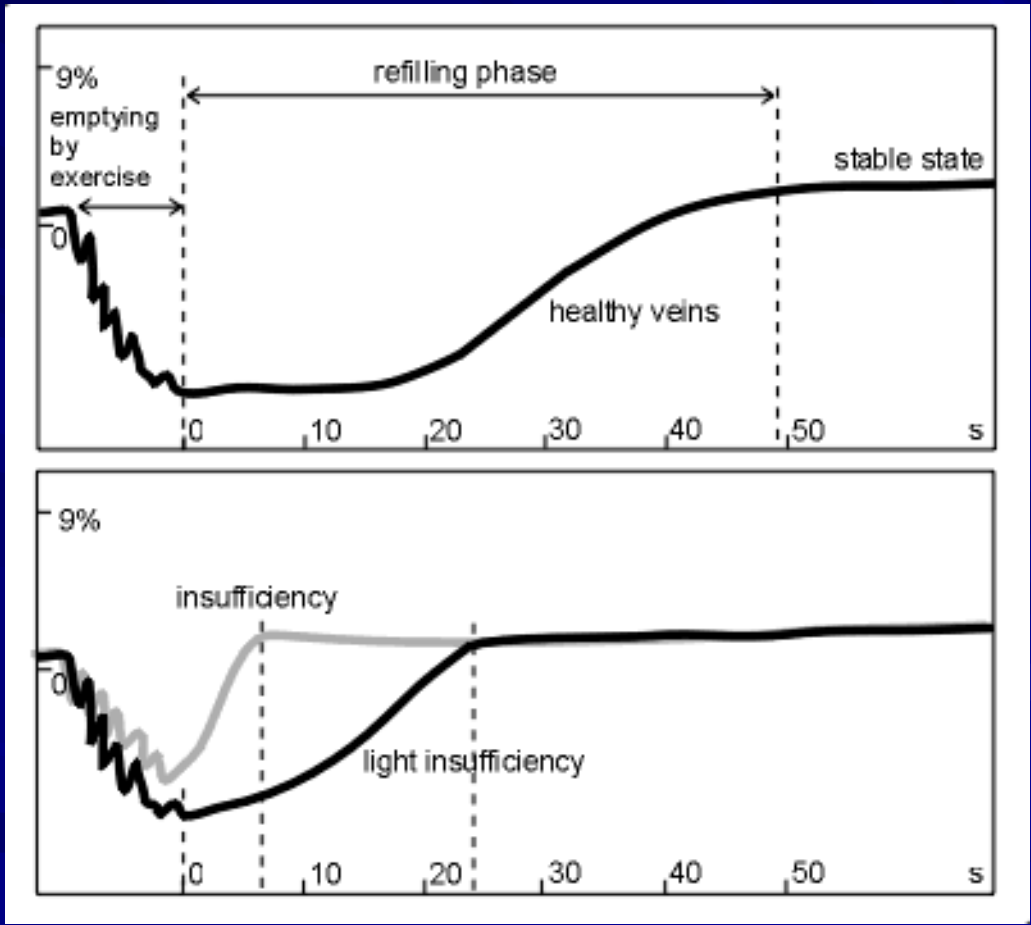
1. Fibrin cuff theory - pericapillary fibrin cuffs, act as oxygen diffusion barrier.
2. Decreased capillary flow >WBC activation>chronic inflammation
3. Focal microvascular ischemia

Evaluation

- Doppler and/or Duplex ultrasound examinations to determine which anatomic sites are involved
- Photoplethysmography is probably the easiest method to determine what effect these abnormalities have on the function of the venous system.

Photoplethysmography

Photoplethysmography

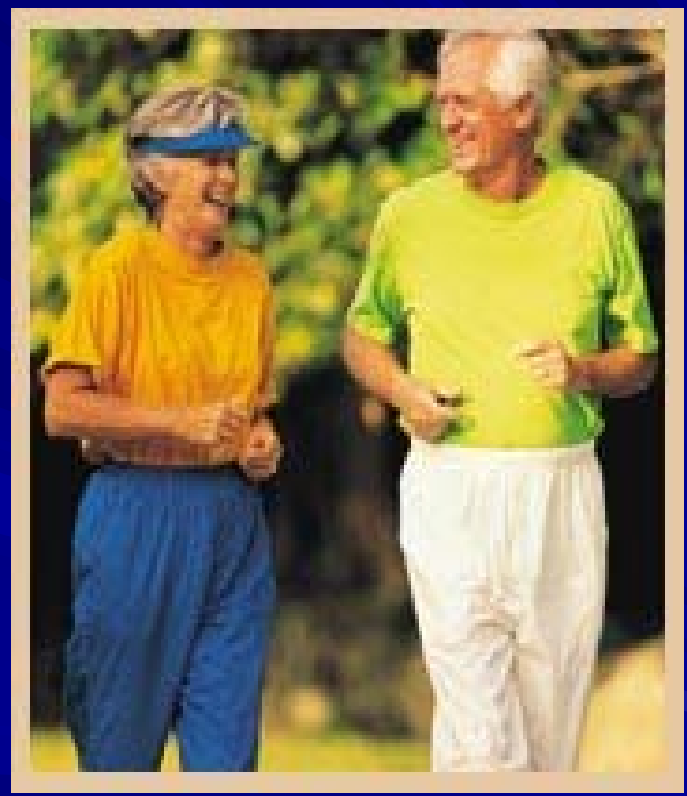


Treatment

- All patients with venous disease, from telangiectatic veins to venous ulceration, may benefit from conservative measures designed to decrease venous distension and reduce ambulatory venous hypertension.

Treatment

- Weight bearing activities that emphasize ankle flexion.
- 30 minute period of continuous exercise should be performed daily
- It is advisable to suggest a modest beginning regimen



Treatment

- Raising the feet above the level of the heart for 15-30 minutes several times per day may reduce symptoms and edema
- Impractical for most people.

Treatment

- Reduces the diameter of the veins
- Activates the fibrinolytic activity
- Reduces filtration of fluid out of the intravascular space and improves lymphatic flow
- Reduces reflux and improves venous outflow
- Anti-inflammatory

Compression

- Elastic compression stockings or bandages
- Inelastic compression garments or bandages
- Pneumatic compression pumps

Elastic Compression

- Generally easy to apply, and available in very aesthetically acceptable forms
- Reduce the severity of symptoms and retards the progression of disease.
- Fitting must include measurements of the ankle, calf, thigh, and hip as appropriate to the length of the stocking.
- Stockings that are sized simply by the height and weight of the patient may result in the production of a harmful pressure gradient

Elastic compression

- The elastic in the stocking recoils and creates inward pressure on the leg.
- This pressure may prevent the movement of blood from the superficial to deep system.
- In this way, the efficiency of the musculovenous pump is compromised in some patients by the use of elastic compression stockings.

Elastic compression

- 100% of the stated pressure should be generated at the ankle level, 70% of the pressure should be generated at the upper calf, and only 40% of the initial pressure remains at the thigh level
- Stockings that are poorly fit may actually generate a reverse gradient, leading to a "tourniquet effect"

CLASS	**PRESSURE** (approximate)	**INDICATIONS** **(suggested)**
I	20-30mm Hg	Aching, swelling, telangiectasias, reticulars
II	30-40mm Hg	Symptomatic varicose veins, CVI, post-ulcer
III	40-50mm Hg	CVI, post-ulcer, lymphedema
IV	50-60mm Hg	CVI, post-ulcer, lymphedema

Elastic compression

- Most patients will respond to a calf high stocking, since this is where we need to assist the pump.
- However, patients with painful varicose veins above the knee, or those with superficial thrombophlebitis above the knee will require a thigh high stocking.

Inelastic compression

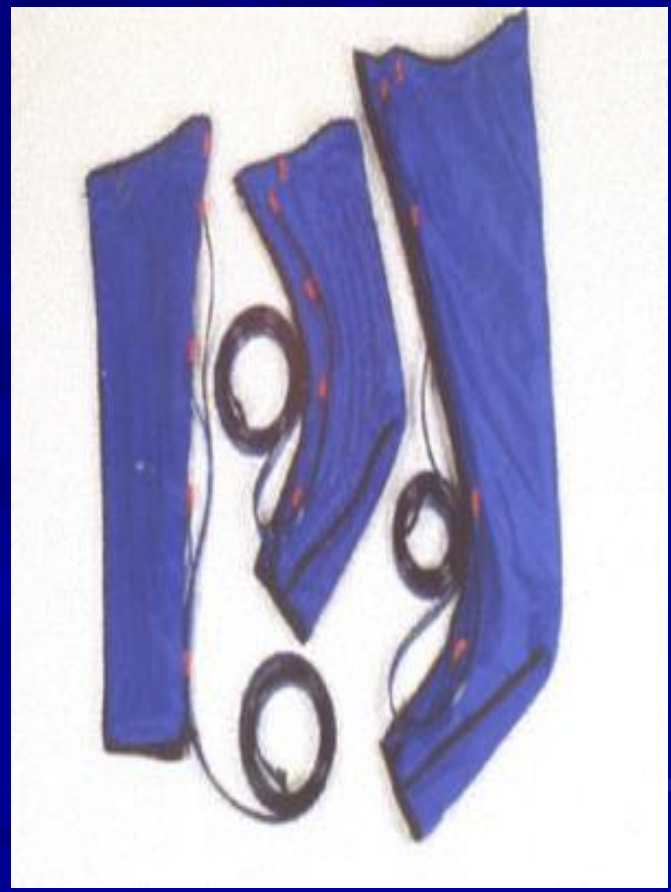
- Inelastic compression augments the emptying of the veins by providing a rigid envelope around the leg.
- Allows all of the force of the muscular contraction to be directed inward, to emptying the deep veins

Inelastic compression

- More costly and cosmetically unacceptable.
- Need to be reapplied several times each day, as the edema resolves.
- More helpful than elastic compression in patients with serious forms of venous disease such as venous ulceration, chronic venous insufficiency, and intractable symptoms due to varicose veins

Pneumatic compression

- Pneumatic compression pumps are an effective adjunct when patients have lymphedema, venous ulceration, or severe edema.
- Generally, the more chambers the pump has, the more effective it is.
- Pneumatic pumps should not be considered a primary therapy



Sclerosing

- Varicosities and telangiectasias
- The key goal is to deliver a **minimum** volume and concentration of sclerosant that will cause irreversible damage to the endothelium of the abnormal vessel to be sclerosed, while leaving adjacent normal vessels untouched.
- Induce irreversible endothelial injury

Sclerosants

- **Detergents**
- **Hypertonic and Ionic Solutions**
- **Cellular Toxins**

Surgery

- General appearance
  Aching pain
  Leg heaviness
  Easy leg fatigue
  Superficial thrombophlebitis
  External bleeding
  Ankle hyperpigmentation
  Lipodermatosclerosis
  Atrophie blanche
  Venous ulcer

Surgery

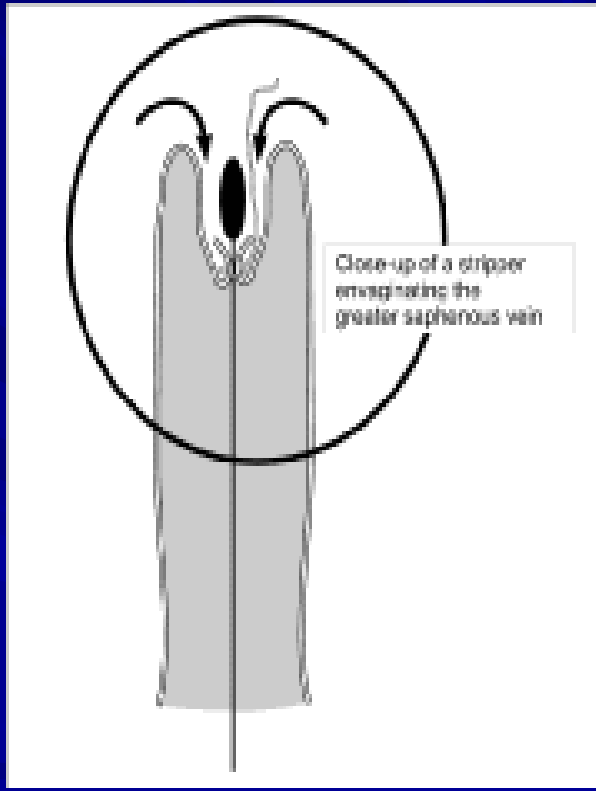
- If it refluxes, take it out.
- The primary goal of surgical therapy is to improve venous circulation by correcting venous insufficiency through the removal of major reflux pathways.
- Preservation of patency of the saphenous vein and continued reflux in the saphenous vein have been found to be the most frequent elements in recurrence.

Surgery

- The object of excision of the saphenous vein is to remove its gravitational reflux and detach its perforator vein tributaries.
- It has been found unnecessary to remove the below-knee portion.
- Stripping and ambulatory phlebectomy are traditional approaches to the ablation of venous reflux,
- Graduated compression is suggested in all patients
- Activity is particularly important after treatment by any technique because all modalities of treatment for varicose disease have the potential to increase the risk of DVT

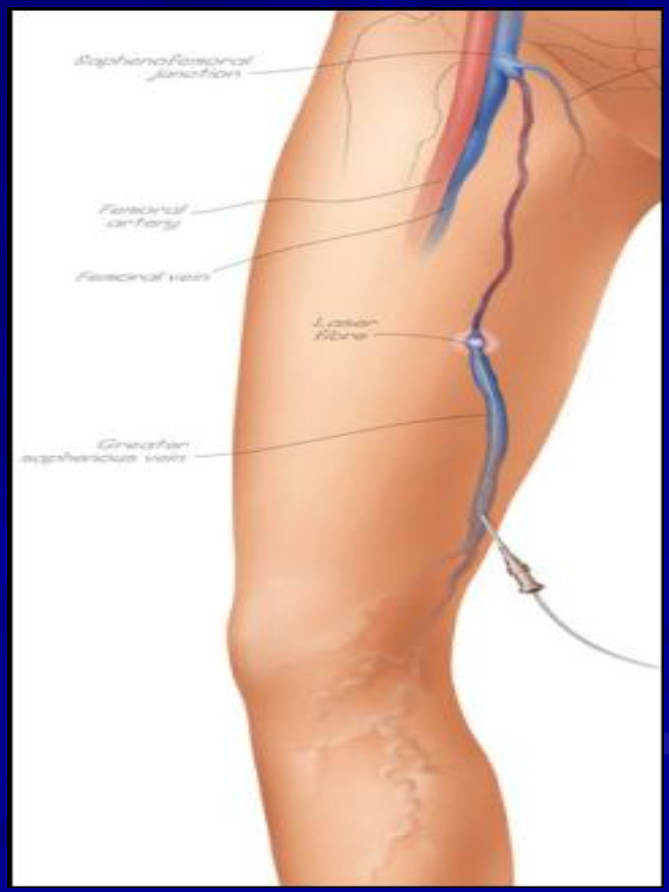
Surgery

- High ligation without saphenectomy has a high rate of early recurrent reflux through the same incompetent vein.
- Saphenectomy guarantees the elimination of axial reflux through the vein that has been removed



Endovenous laser

- Successful endovenous laser treatment was seen in 490 of 499 (98%) limbs at 1 month follow-up.
- 310 of 318 (97.5%) at 1 year
- 113 of 121 (93.4%) at 2 years



SEPS procedure

- 832 patients with CEAP clinical class 4-6, chronic venous insufficiency (CVI) and incompetent perforator veins (IPVs)
- After surgery, 92% of the C6 patients were able to heal their ulcers in a mean time of 7 weeks, and only 4% experienced ulcer recurrence during a 3.5 year mean follow-up.