

Decisions regarding Salvage and Local flap Coverage of Lower Limb Trauma

Dr Anthony Kane
Plastic and Reconstructive Surgeon
Princess Alexandra Hospital, Brisbane

Disclaimer

- The copy in this file is protected by the copyright of the author or authors. Consent was provided for the express purpose of educating attendees of the 2012 Registrar's Conference in Brisbane.
- You **MAY NOT** copy or distribute the contents or images in any form.
- You **MAY PRINT** the document for your own personal use as an educational resource.

Classification of open limb injuries

Gustilo and Anderson (1976 JBJ Surg)

- Type I associated wound <1cm
- Type II laceration >1 cm but no extensive soft tissue damage, flaps or avulsion
- Type IIIA adequate soft tissue coverage of the fracture despite extensive flaps or any injury from high energy trauma
- Type IIIB extensive soft tissue loss perisoteal stripping and heavy contamination , fracture exposed
- Type IIIC an arterial injury requiring repair

Classification of open limb injuries

Byrd, Spicer and Cierny (PRS1985)

- Type I Low energy forces causing a spiral or oblique # with skin lacerations <2 cm and relatively clean
- Type II Moderate energy forces causing comminution or displaced # with skin laceration >2cm and moderate adjacent skin and muscle contusion but without devitalised muscle

Classification of open limb injuries

Byrd et al cont

- Type III High energy forces causing significantly displaced # with severe comminution ,segmental # or bone defect with extensive loss of skin and devitalised muscle
- Type IV # same as type III but with extreme energy forces as in high velocity gunshot, history of crush or degloving or associated vascular injury requiring repair

assessment

- Overall condition of the patient- ? Other injuries / conditions
- Assess the level of the injury
- Assess the local soft tissues
- The pedal pulses
- Sensation of the foot especially the sole
- Look at the xrays
- Discuss the bony reconstruction with the Orthopaedic team

Debridement

- Excise skin to bleeding edges Usually 1 cm margin if heavily contaminated
- Debride all pale muscle or muscle that doesn't move on diathermy. Beware pale muscle that bleeds.
- Look particularly at the deep posterior compartment
- Butterfly segments should be removed if cover not in 24 to 48 hours
- Wash out with pulsed saline at least 4 litres
- Don't cut the longitudinal white things they are usually important

Coverage

- Timing best within the first week Optimally within the first 72 hours.
- As a general guide we cover when the wound is clean
- Muscle is most favoured especially where the wound is extensive or where there is significant dead space
- Skin flaps are used if the dead space is minimal eg Ankle #
- Bone flaps may be used where segmental losses exceed 10 cm

Coverage- Timing

Godina et al (PRS 1986) reviewed his experience with 532 patients after **free flap** transfer to the lower limb

- group 1 transfer within 72 hours
- group 2 transfer within 72 hours to 3 months
- group 3 after 3 months

Godina et al Results

- Initially a 26% failure rate which reduced to 4% in the last 100 cases. Most units around this latter figure.
- Flap loss group 2>3>1 (12% to .75%)
- Infection Group 2>3>1 (17.5% to 1%)
- Time to union 3>2>1 (29 Months to 6.8 months)

Byrd and Cierny coverage results

- 131 patients type 3 and 4 according to their classification
- advocated radical bone and soft tissue debridement
- Ideal coverage with free flaps within 5-6 days
- after this they felt the wound went into a subacute colonised stage for 6 weeks and then a chronic phase with granulation and pockets of infection
- this latter phase they felt had higher infection, flap failure and non union due to the difficulty debriding the bone adequately

Key Points

- **Debridement** is the key
- after the first week arguably the wound becomes colonised heavily. Thus bone debridement becomes critical and more difficult. **Early** is best
- **Muscle flaps** are favoured
- **Free flaps** are favoured due to the massive trauma to the local tissues. Thus the local flaps become more unreliable
- crush, degloving and high energy forces lead to flap loss, infection and delayed healing

Why muscle?

- Can provide massive coverage if needed
- fills in the dead space very well
- resists infection by being so vascular and therefore improves the delivery of antibiotics to the area
- can wrap around the whole bone to provide a well vascularised cuff

Indications for local flaps

- Small defects where free flap is overkill
- upper two thirds of the lower leg
- sick patient
- local tissue is ideal for the specialised task of the area to be reconstructed
- microsurgical contraindication, lack of training or facilities

Contra indications

- No available local tissue due to extent of the trauma severe or local crush
- compromised local blood supply either premonitory or secondary to the trauma
- where the transfer may compromise blood supply distally
- Infection
- Leg not a viable salvage (see later)

Flaps available

- Random pattern flaps
- fasciocutaneous flaps including adipofascial flaps
- muscle flaps

Upper third of leg

- Medial head of gastrocnemius
- lateral head of gastrocnemius
- proximally based soleus
- fasciocutaneous flaps
- tibialis anterior

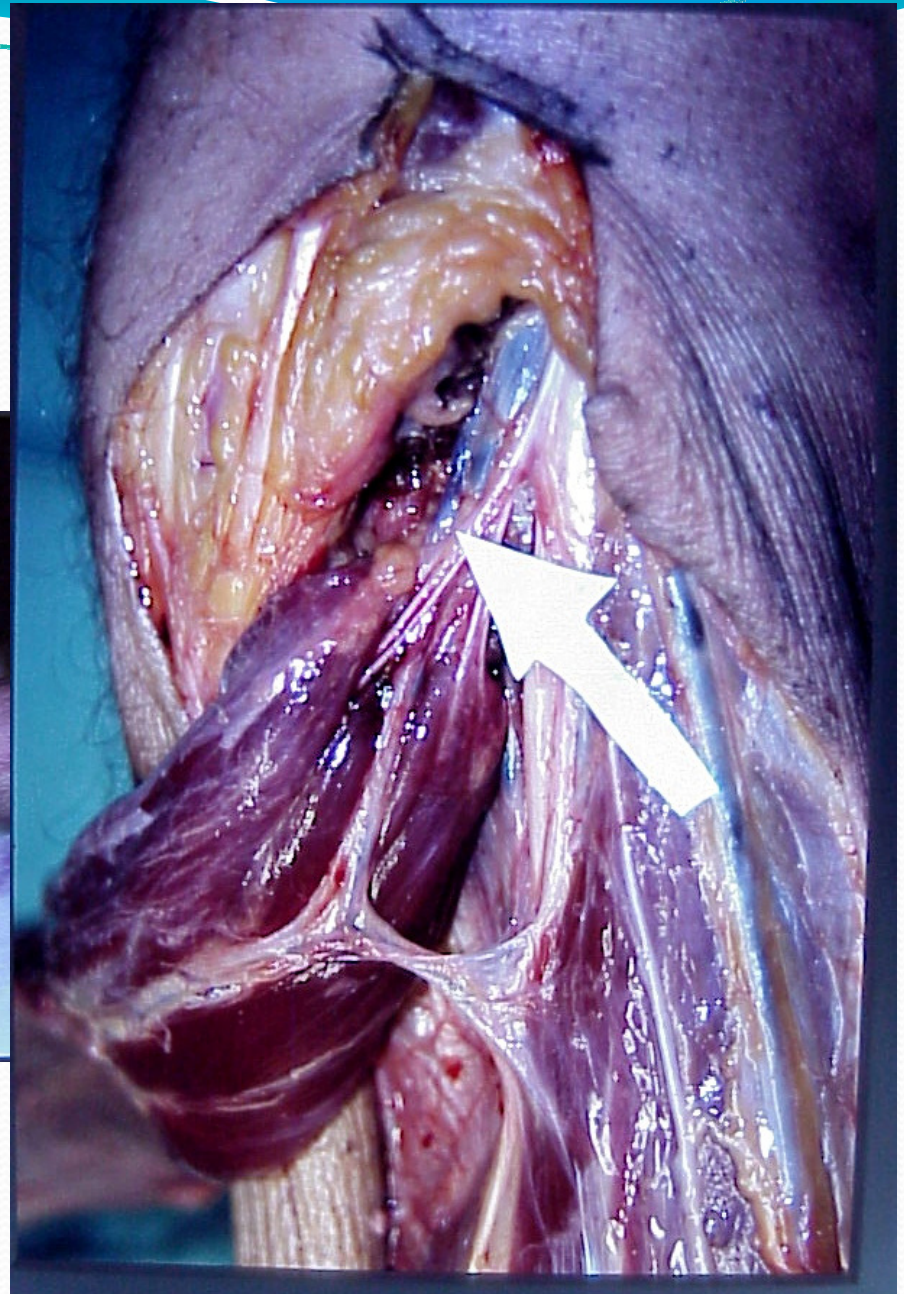
Medial head of Gastrocnemius

- Very versatile flap to cover knee to junction of mid and lower tibial thirds and lower thigh
- type 1 muscle
- 85% have a single vascular pedicle and all a single motor nerve
- intramuscular vessel may be single or double

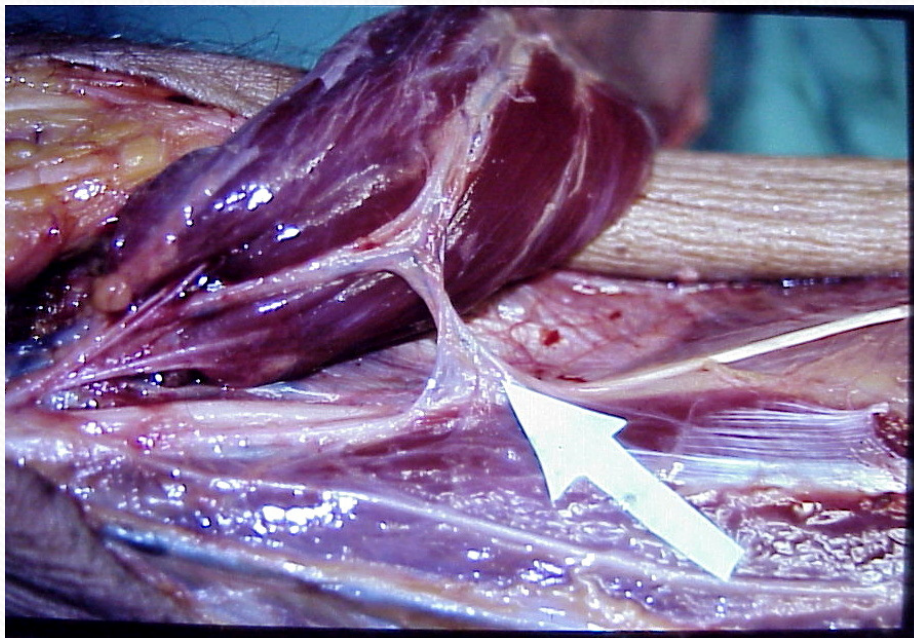
Manoeuvres in raising gastroc flaps

- Midline dorsal incision with z across popliteal fossa
- dissect between heads, identify the pedicles
- divide distally and then proximally
- to increase reach remove the fascia front and back or at least score it
- dissect vessels into muscle and remove excess muscle around the pedicle

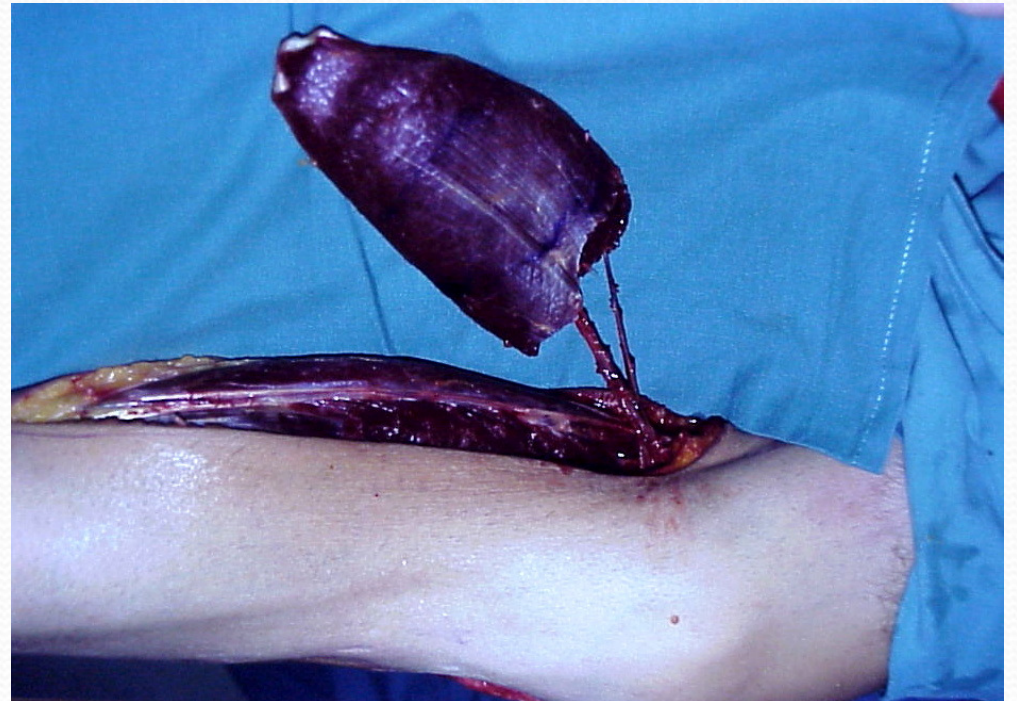
Gastroc flap



Gastroc flap



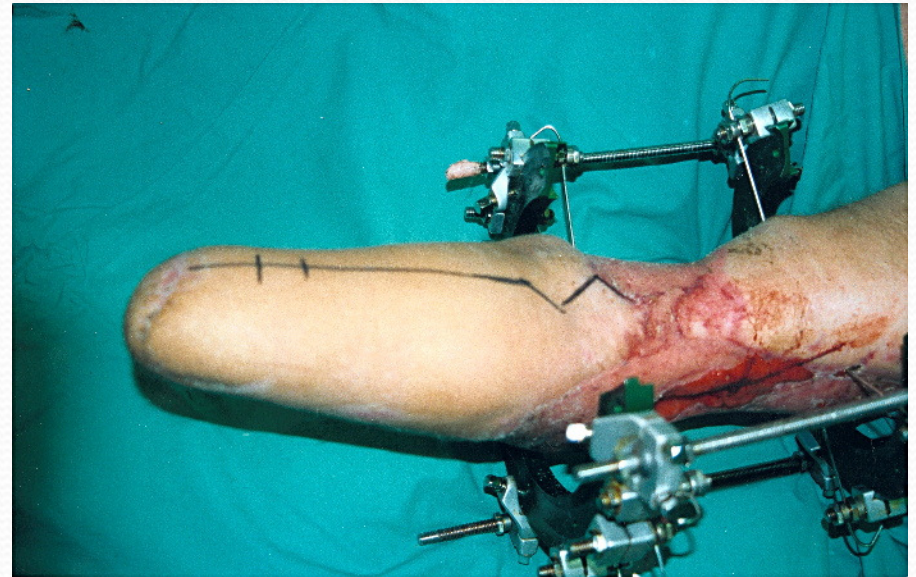
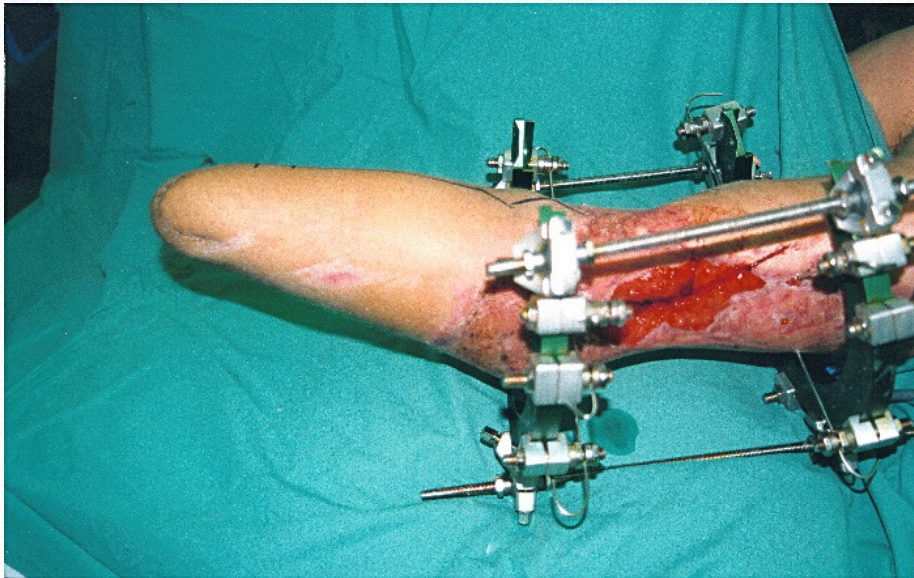
Gastroc flap



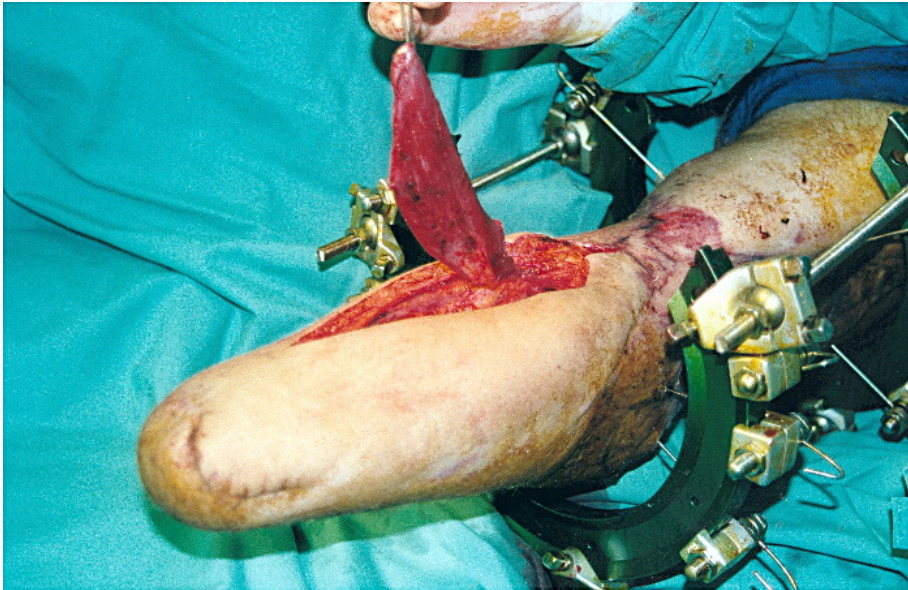
Gastroc flap



Gastroc flap



Gastroc flap

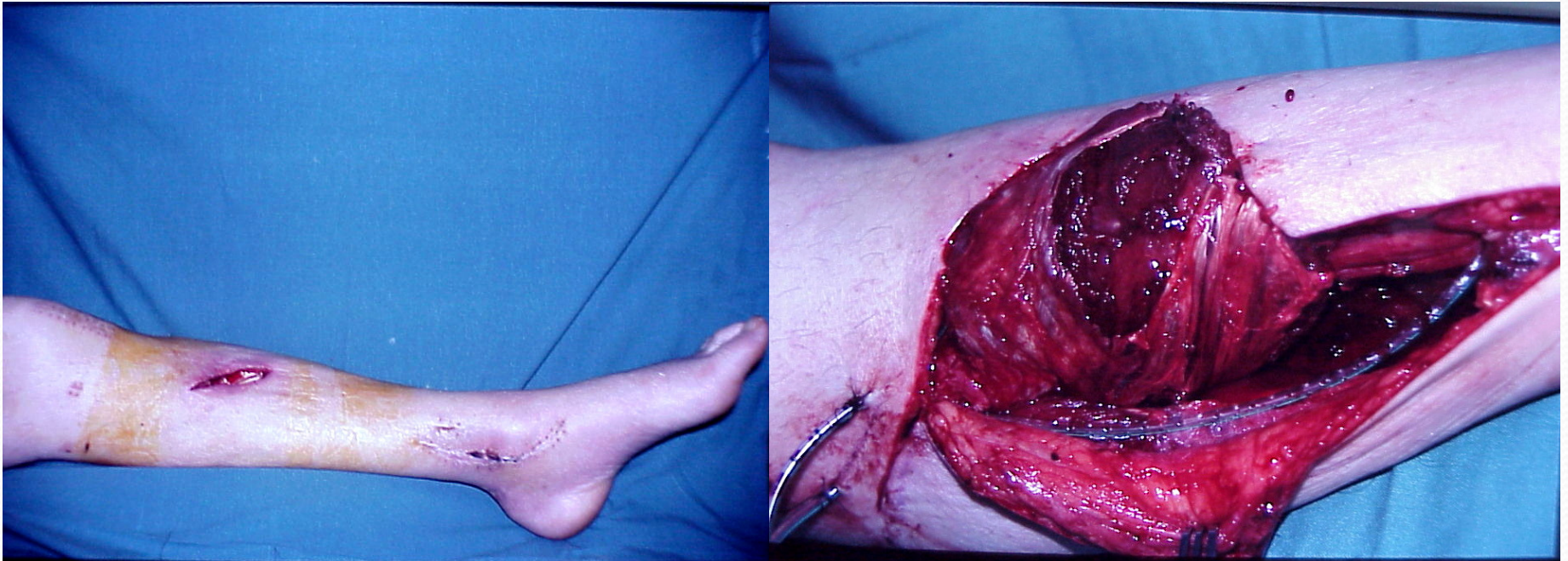


- On the lateral side have to avoid the common peroneal nerve . This lies on the head of the lateral gastroc and is easily avoided but tension on the nerve should be discouraged

Soleus flaps

- Dual supply through a number of perforators from the peroneal and posterior tibial bundles and the popliteal vessels
- can be raised on both systems or on one system , half the muscle only or reversed
- type 4 muscle
- main disadvantage is the loss of the venous pump in the lower leg

Hemi-soleus Flap



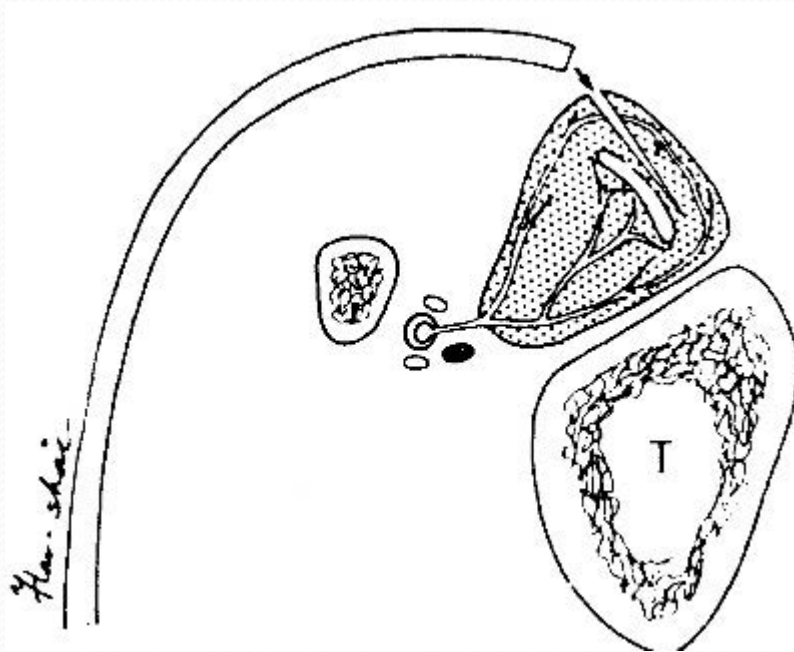
Soleus flap



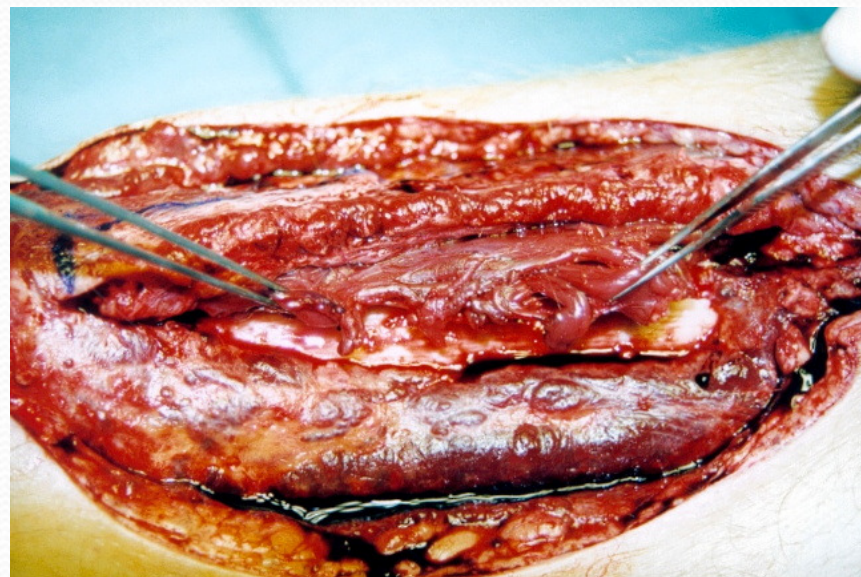
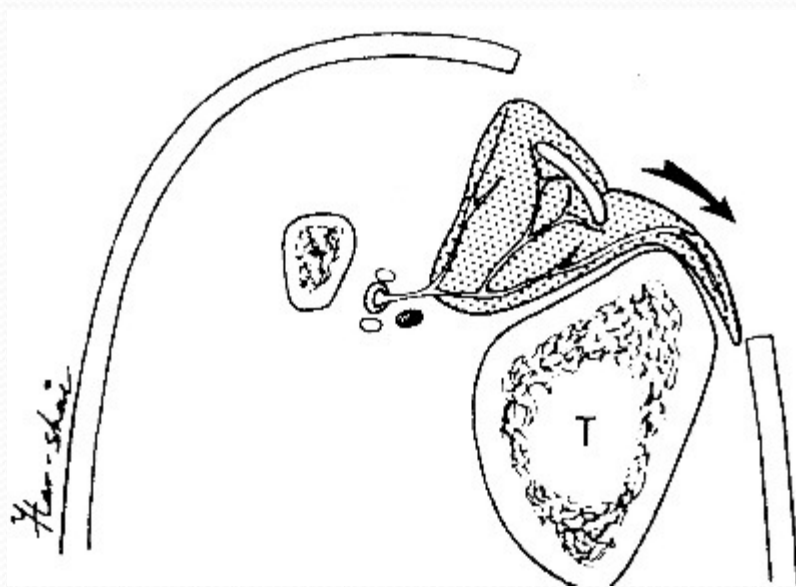
Tibialis Anterior



Tibialis Anterior



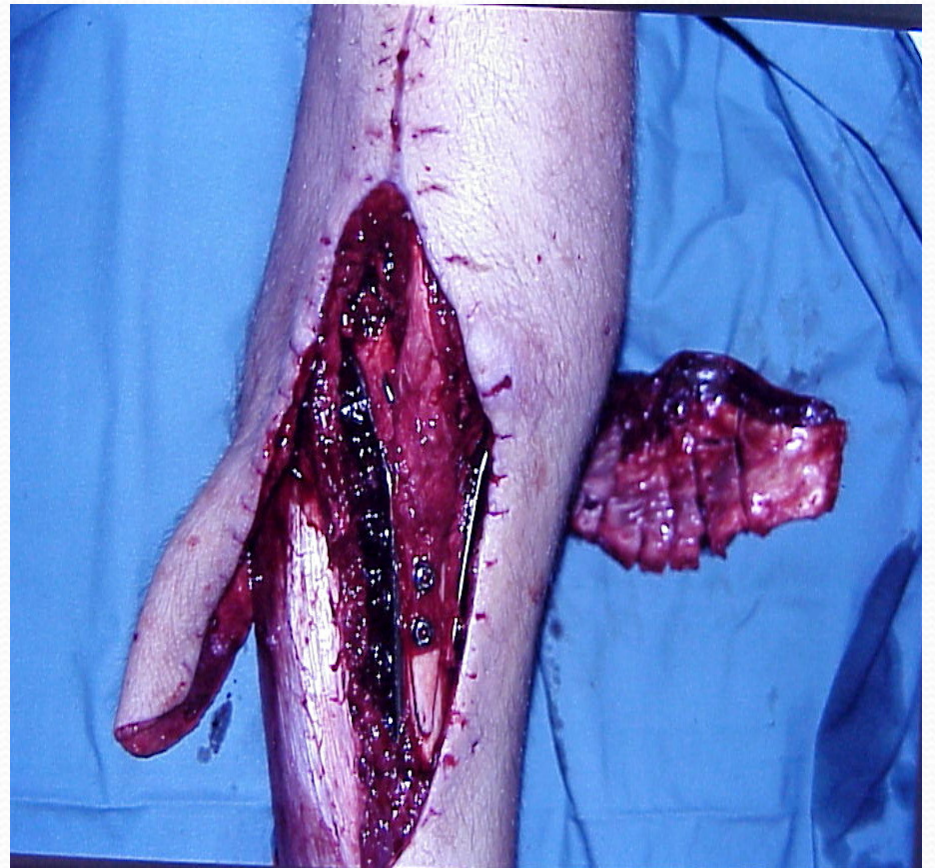
Tibialis Anterior



Tibialis Anterior



Fasciocutaneous



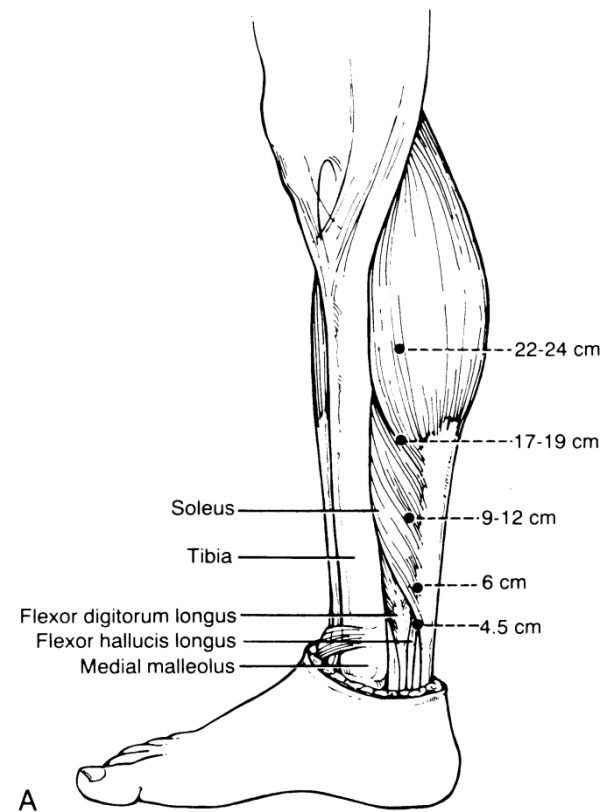
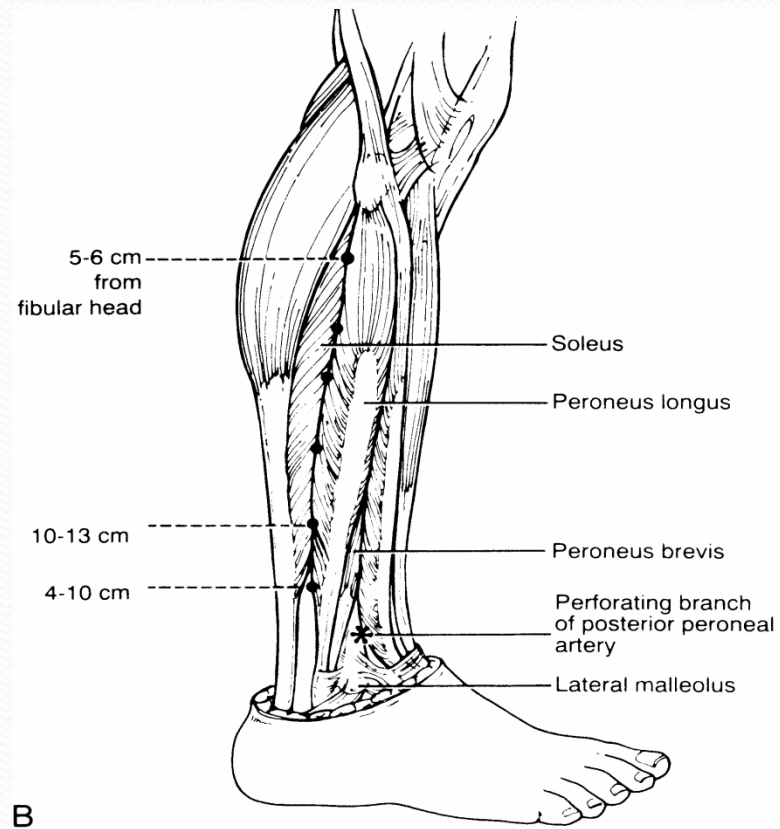
Fasciocutaneous flap



Lower third of the Tibia/ Ankle

- Local tissue difficult to use and often free transfer is the best option
- fasciocutaneous flaps
- extensor digitorum brevis
- dorsalis pedis

Fasciocutaneous flaps



Blood supply to the lower limb

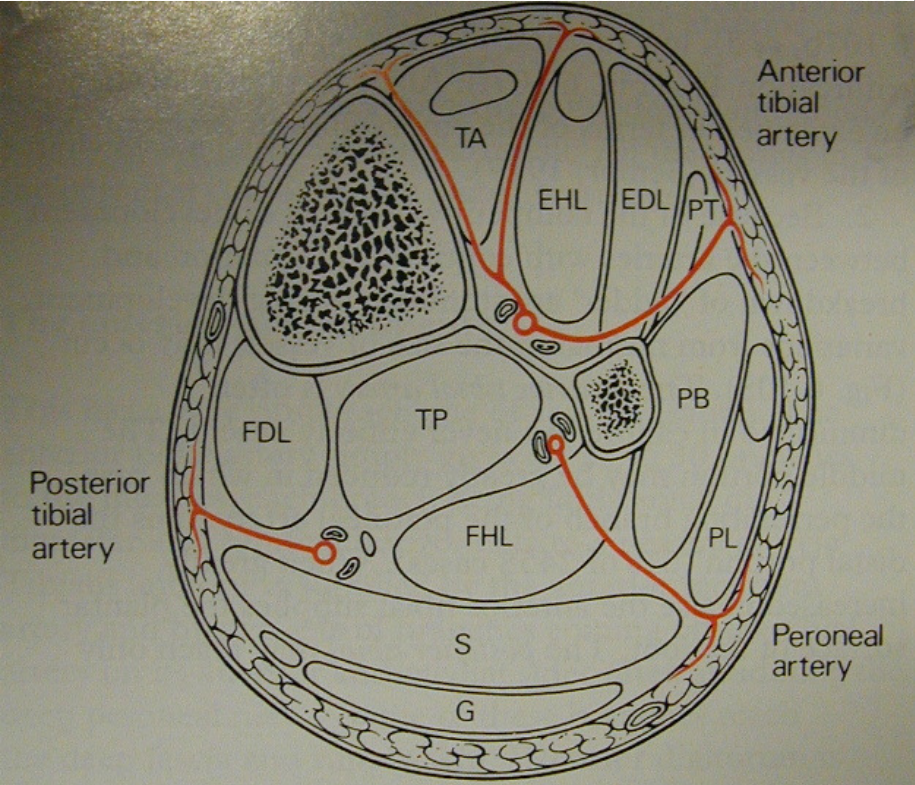
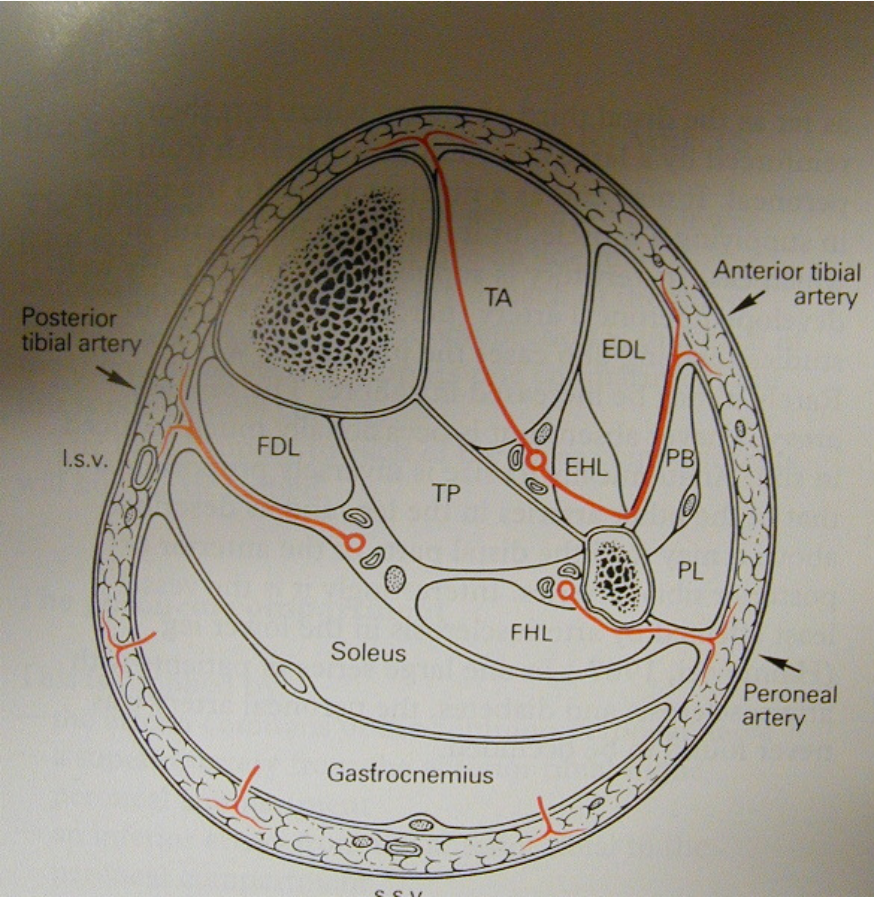
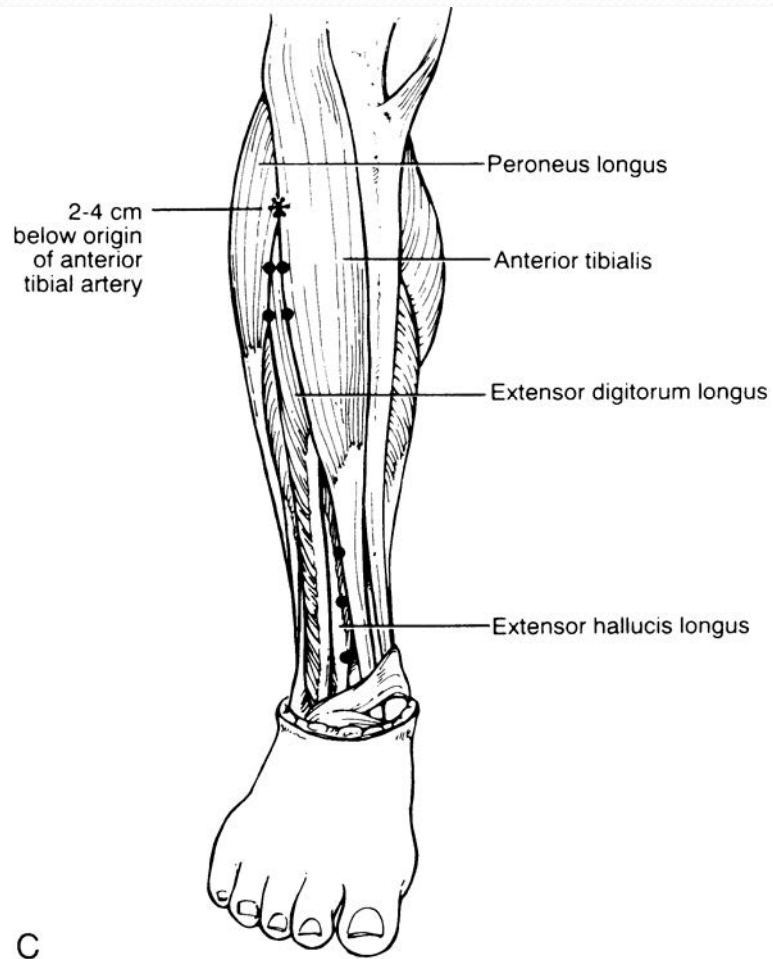


Fig. 6.105 Schematic transverse section through the lower third of the lower leg.

Fasciocutaneous flaps

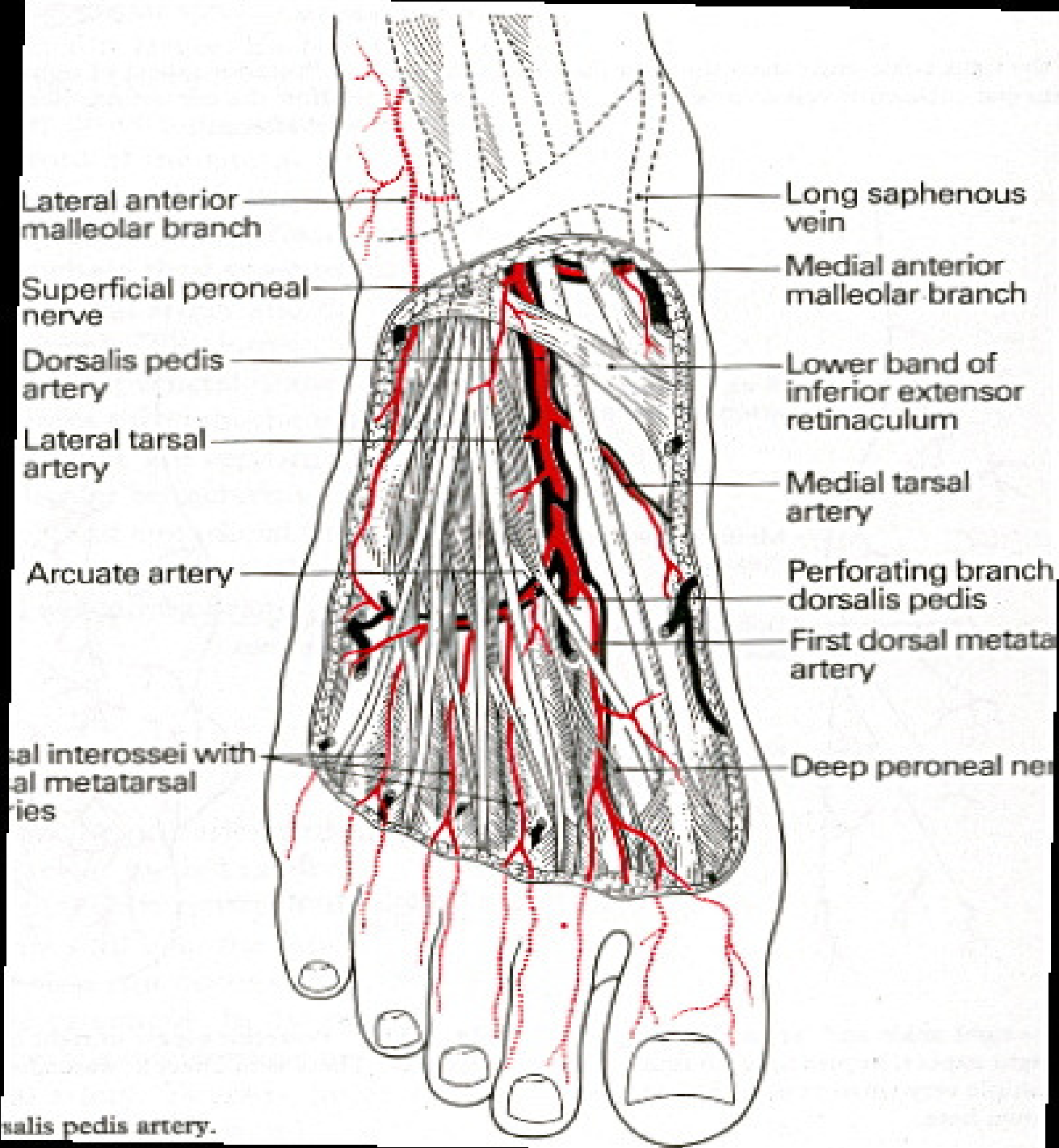


Fasciocutaneous flaps



Reverse Sural flaps





Lateral anterior malleolar branch

Superficial peroneal nerve

Dorsalis pedis artery

Lateral tarsal artery

Arcuate artery

Metatarsal interossei with digital metatarsal arteries

Long saphenous vein

Medial anterior malleolar branch

Lower band of inferior extensor retinaculum

Medial tarsal artery

Perforating branch dorsalis pedis

First dorsal metatarsal artery

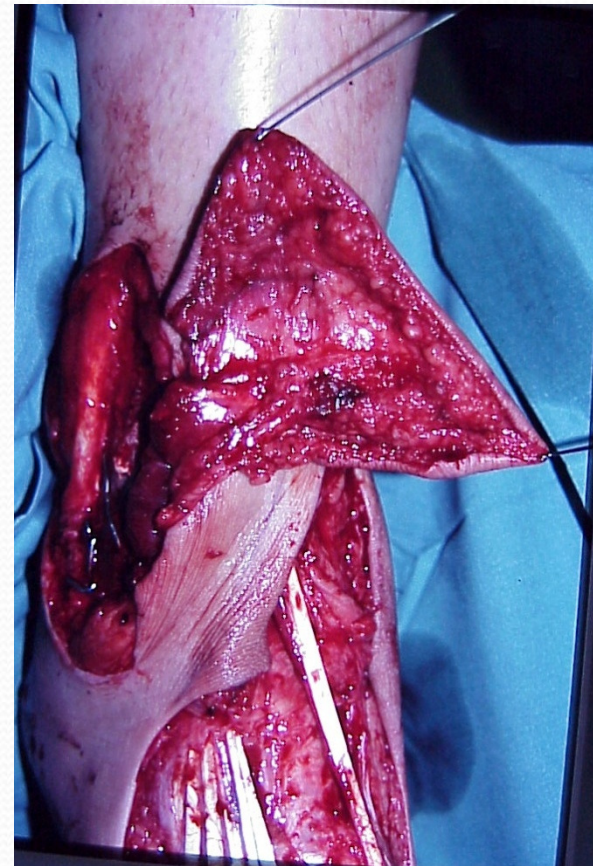
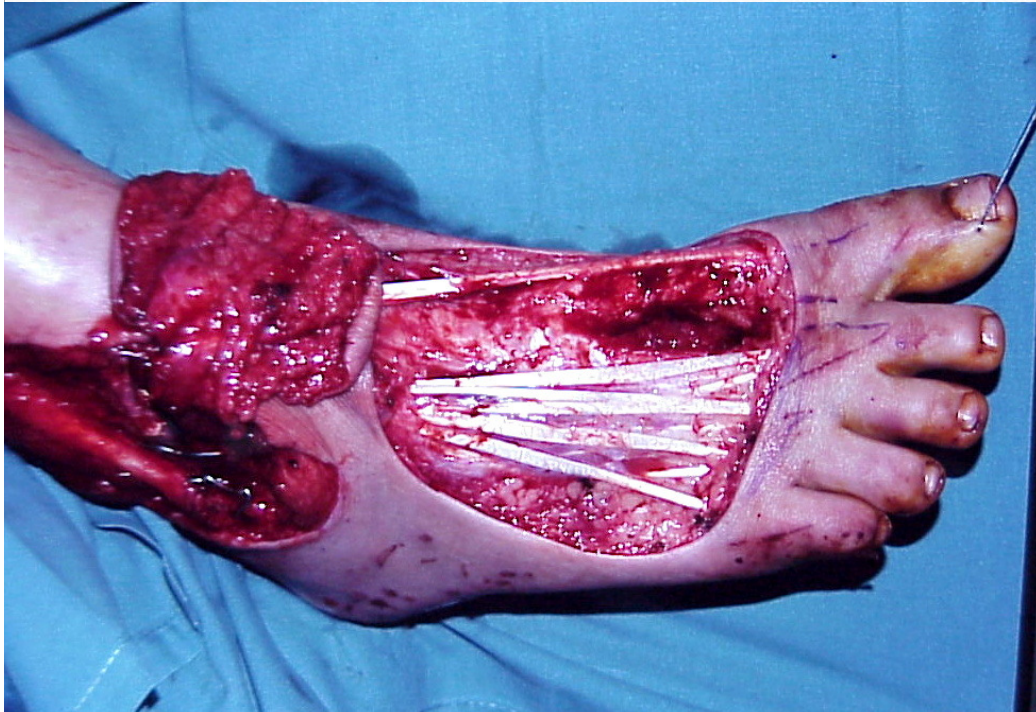
Deep peroneal nerve

Dorsalis pedis artery.

Dorsalis pedis flaps



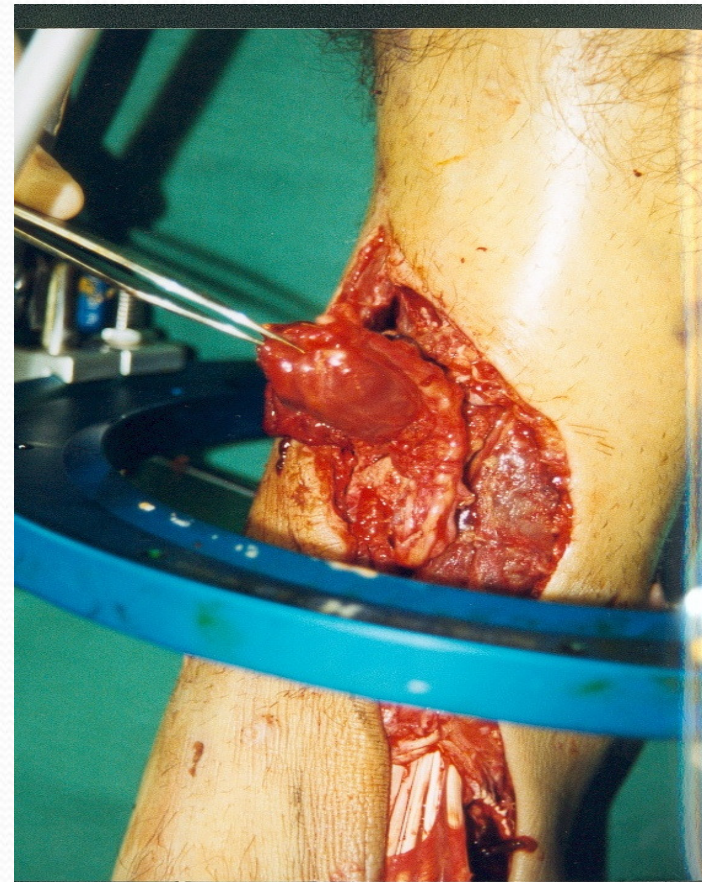
Dorsalis pedis flaps



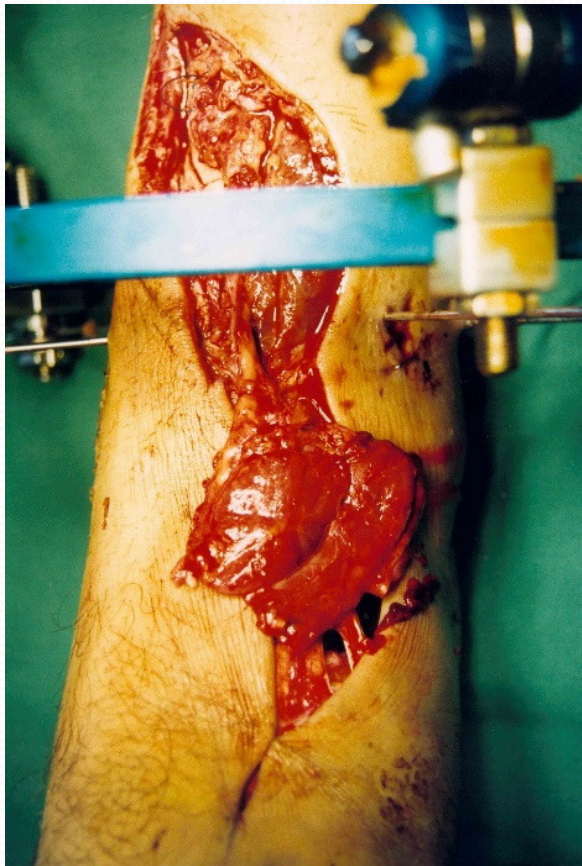
Dorsalis pedis flaps



Extensor Digitorum Brevis flap



Extensor Digitorum Brevis flap



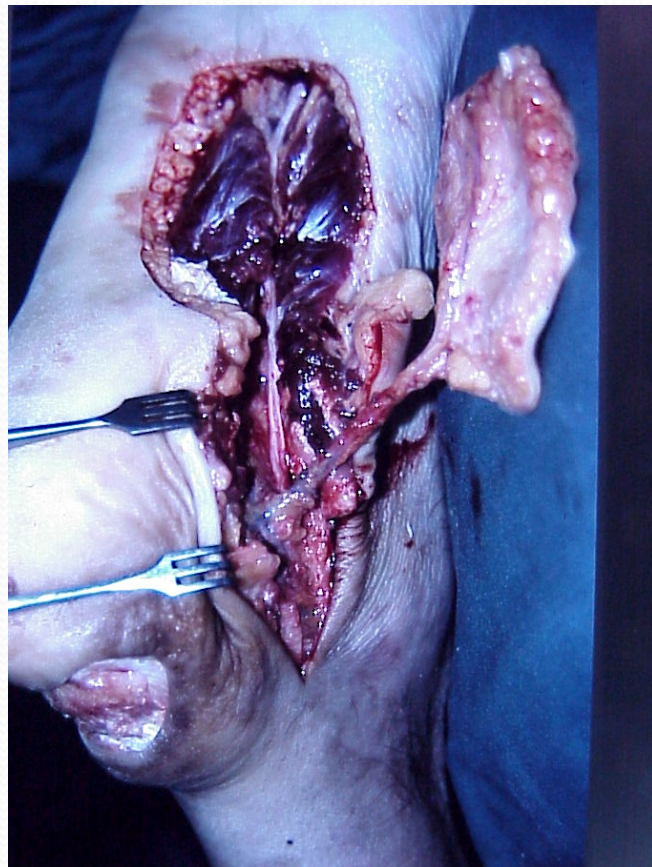
Sole of the foot

- Specialised glabrous skin
- reconstruction requires similar properties ie glabrous skin with thick epidermis and compartmentalised fat with firm attachment to plantar fascia
- preferably sensate

Medial plantar island flap



Medial plantar island flap



Medial plantar island flap



Local flaps

- Very useful in the setting of tumour reconstruction and low velocity trauma
- the gastrocnemius flap is one of the workhorses of lower limb reconstruction
- Medial plantar flap the flap par excellence for the sole of the foot
- downsides are the their use in higher velocity trauma where the pedicle is not out of the zone of trauma

Who should be reconstructed or amputated?

- Patient factors : age, medical condition, other injuries or multilevel injuries, psychological
- Fracture factors: velocity of the injury and how likely is union, vascular injury , lack of soft tissue cuff, *possibly the most important is sensation of the sole*
- Godinas stage 3 b and 3c and Byrd stage 3 and 4 are the most likely to require thought about amputation
- Need to consider the chance of union, chronic infection , sensory return and how painful it will be to use

Outcomes of salvage

- Arnez study *Clinics of Plastic Surgery* 1991
- Free flap success rate high Gustillo 3b 3.6 % complication rate if done within 15 days
- 93 % salvage of the lower limb
- 66% suffered restricted ROM in ankle, 44% long term oedema requiring garment, 50% required assistance with ambulation occasionally
- Long term unemployment rate 28%, no return to work >2 years unemployment
- Amputees 68% working within 2 years

Outcomes cont.

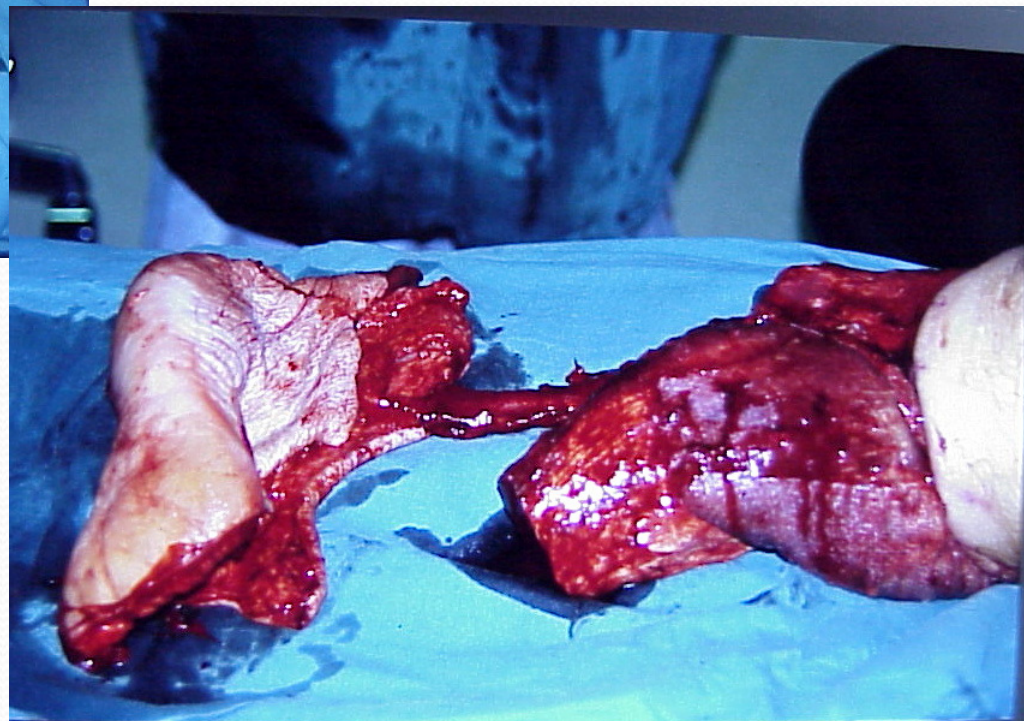
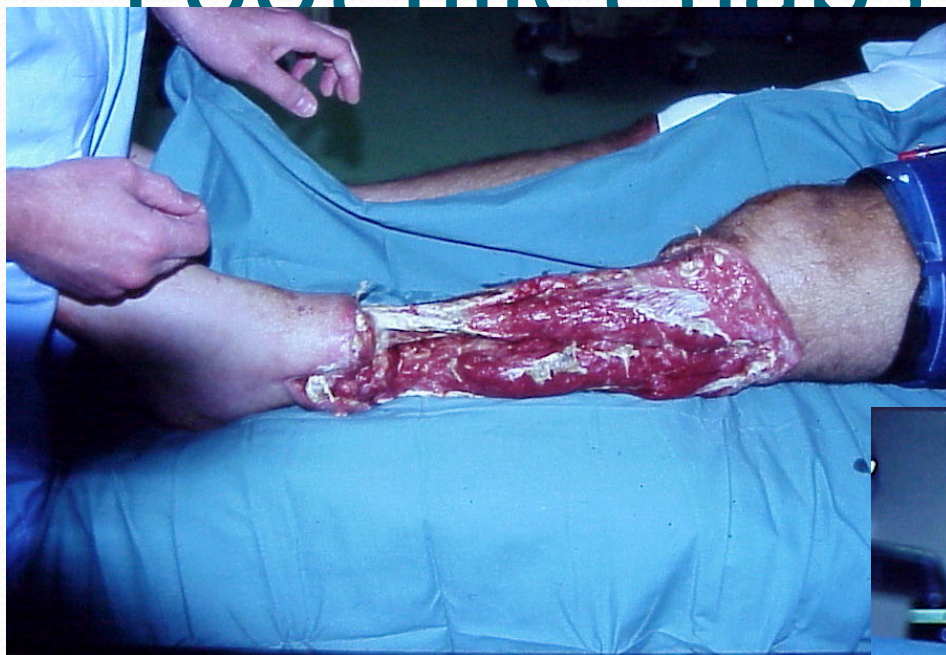
- Khouri and Shaw
- Free flap failure rate 8% compared to 3% elsewhere
- Double the anastomosis failure rate where there had been vascular trauma
- Triple in large bony defects
- Quintupled if vein grafts needed
- Therefore failure reflected the extent and force of the trauma



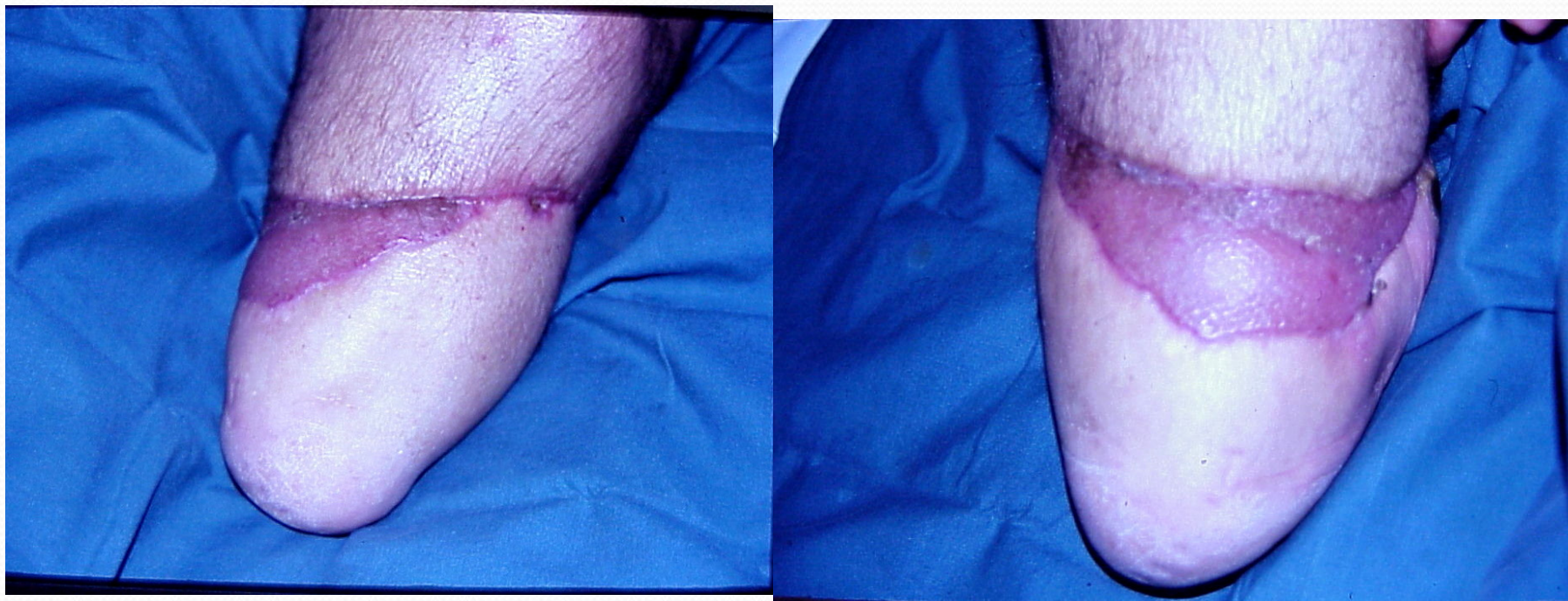
Aims of amputation

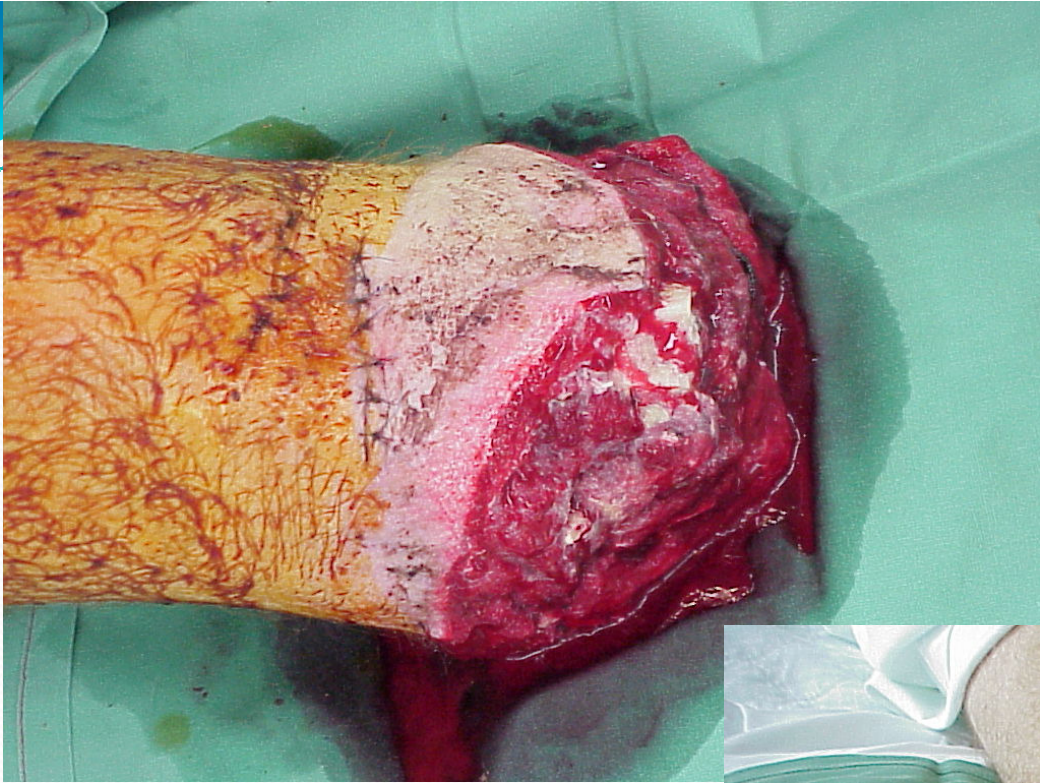
- As long a stump as possible with a mobile joint above it
- Coverage of the stump needs to be stable with adequate padding of the bone
- Sensation
- BKA > through knee > AKA
- Allow early rehab and mobility and hopefully return to work
- Always consult the prosthetist for advice and to see patient

Foot fillet flaps as salvage



Foot fillet flaps as salvage





Free Flaps In lower limb reconstruction ?

- To provide massive cover
- surrounding tissue not available due to the trauma
- to provide additional features for the reconstruction eg nerve, tendon repair, bone, to reconstitute the vascularity to the limb or perhaps replace a functioning musculotendinous unit
- Free flaps add versatility to the repair eg longer pedicles , more volume , composites of tissue, flow through

Free flaps

- Tend to use end to side anastomoses for the artery and I use more end to end for the veins
- Superficial veins are more likely to be crushed and or thrombosed in trauma
- try to anastomose to vessels outside the zone of trauma

