McCraw and Arnold's Atlas of Muscle and Musculocutaneous Flaps

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EXTENSOR DIGITORUM COMMUNIS

ANATOMICAL CONSIDERATIONS

Surface Markings

The extensor digitorum communis (EDC) muscle passes on a line from the head of the fibula to the midpoint of the anterior ankle. The EDC muscle is easily palpated in either the thin or the muscular individual.

Origin and Insertion

The EDC muscle originates from the lateral border of the upper two-thirds of the tibia and from the medial border of the fibula. The muscle becomes completely tendinous in its distal-third. After passing beneath the extensor retinaculum, the muscle inserts into the proximal phalanges of the second through the fifth toes. The function of the EDC muscle is duplicated by the extensor digitorum brevis muscle (short extensors) in all but the fifth toe. This long extensor toe function can also be replaced by a tenodesis of the extensor digitorum communis muscle to the extensor hallucis longus muscle.

Adjacent Muscle

Superiorly the EDC muscle lies between the tibialis anterior and the peroneus longus muscles. In the lower pretibial area the EDC muscle passes between the extensor hallucis longus and the peroneus brevis muscles. The superficial sensory branch of the peroneal nerve crosses over the EDC tendons just above the ankle.

Vascular Supply

The EDC muscle is supplied by multiple deep segmental perforating vessels from the anterior tibial artery. There are usually nine to fourteen distal perforators which can supply the distal two-thirds of the muscle as a distally based muscle flap. The number of deep perforators and the size of the "reversed" muscle flap are not anatomically precise because the effective size of the muscle flap is ultimately dependent upon the physiological nature of the intramuscular vascular arborization.

Motor Nerve

Peroneal nerve.

USES

The extensor digitorum communis muscle is used only as a distally based muscle flap to cover the lower one-third of the tibia. A proximally based extensor digitorum communis muscle flap is not even considered because there are better muscle flap options available. Although the "reversed" EDC muscle flap has a remarkable distal excursion, it will not reach the ankle joint nor the dorsum of the foot.

REGIONAL FLAP COMPARISON

A "free" microvascular transfer should always be considered when one is faced with a low pretibial defect. Although a "free" transfer necessitates a longer operative procedure, the time required for healing and the total length of the disability may be less than that of a "reversed" EDC muscle flap. Still, the properly chosen EDC muscle flap should routinely survive a distal transfer, and a "free" muscle transfer currently survives in only 85% to 95% of its pretibial applications. This difference in survivability is related primarily to the preexisting vascular damage within the "zone of injury." Intimal fibrosis of the recipient vessels may be even more extensive than suggested by the arteriogram, and the intimal damage may spread beyond the "zone of injury." An extensive "zone of injury" further diminishes the viability of a "free" flap if it forces one to use long interposition vein grafts between the recipient vessels and the "free" flap.

The proximally based (yes, proximally based) soleus muscle flap can frequently be used for small distal tibial defects. The proximal soleus muscle should always be explored before a "reversed" EDC flap is elevated. The distal excursion of the proximal soleus muscle flap can be surprising, and it may offer a simple solution to some difficult low pretibial problems.

Several other flaps will reach the distal tibia, but each has one or more significant disadvantages. The "island" dorsalis pedis skin flap is neither helpful in obliterating a cavity nor in eradicating infection. The already suspect "reversed" soleus muscle flap may be even more suspect because of preexisting harm to its deep perforating vessels in an extensive "zone of injury." Even when it is usable, the "reversed" soleus muscle flap offers an unsightly reconstruction and notable morbidity. Since the proximal portion of the tibialis anterior muscle originates from the tibia, a "reversed" tibialis anterior muscle flap can be used to "carry" the attached portion of the proximal tibia to a distal tibial bone defect. Other than this unusual transfer of the proximal tibia to the distal tibia, the unique functional importance of the tibialis anterior muscle precludes any other "reversed" flap applications.

DISADVANTAGES

Unlike the robust vitality of standard muscle flaps, any "reversed" muscle flap can be expected to have a markedly decreased blood flow. Fortunately, the distal vasculature of the EDC muscle is reasonably predictable and will generally sustain a "reversed" muscle flap. Muscle flap loss has not been a consistent problem, but the fragility of the "reversed" EDC muscle flap has to be respected. Acceptable toe extension can usually be reconstituted by a tenodesis, but some functional loss can be expected with the use of this muscle flap.

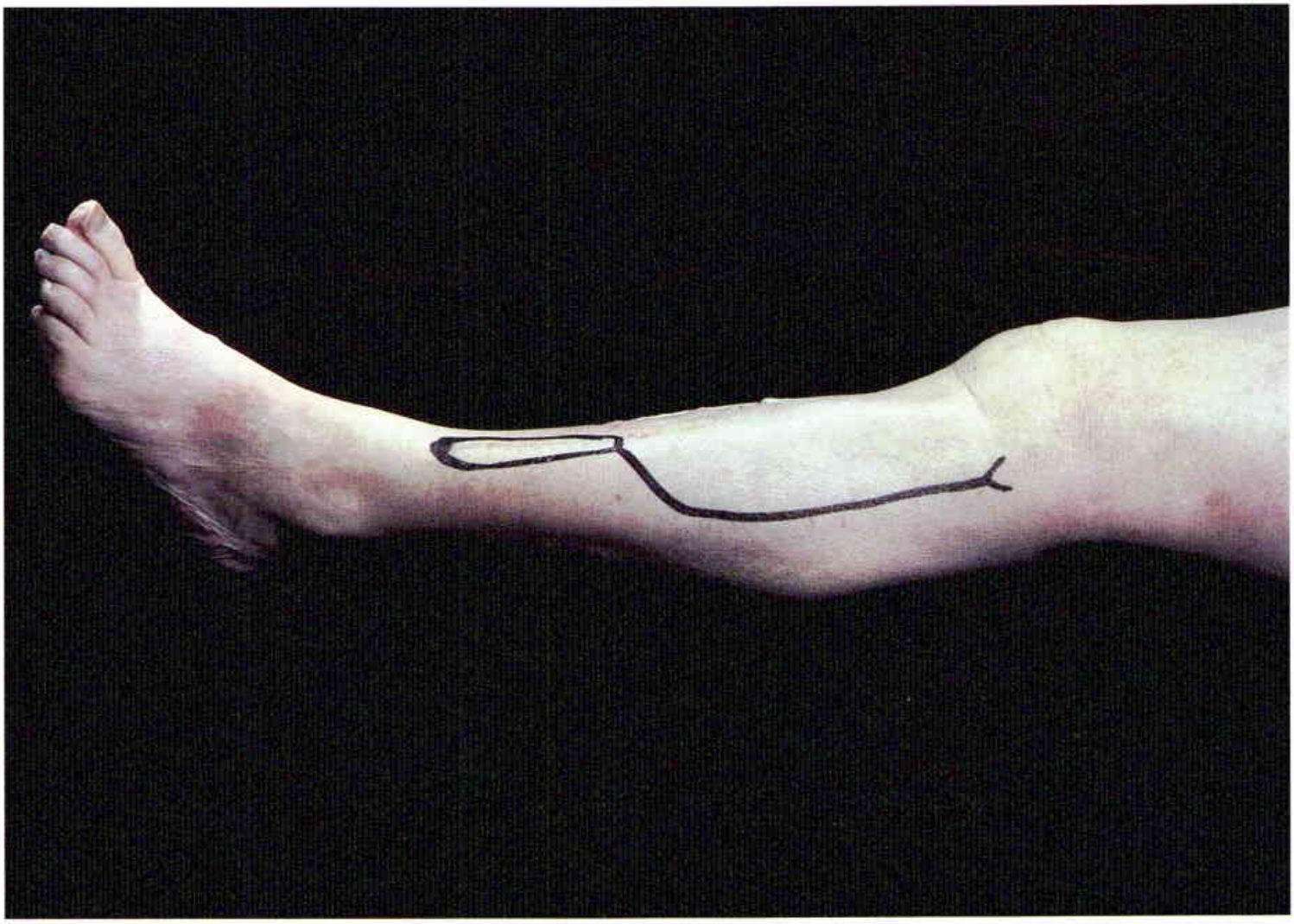
ADVANTAGES

The principal advantage of the "reversed" EDC muscle flap is that it can provide excellent muscle coverage for some of the most difficult problems in the lower third of the tibia without a prolonged microvascular procedure. The donor site is excellent, and the appearance of the skin-grafted muscle flap is quite acceptable.

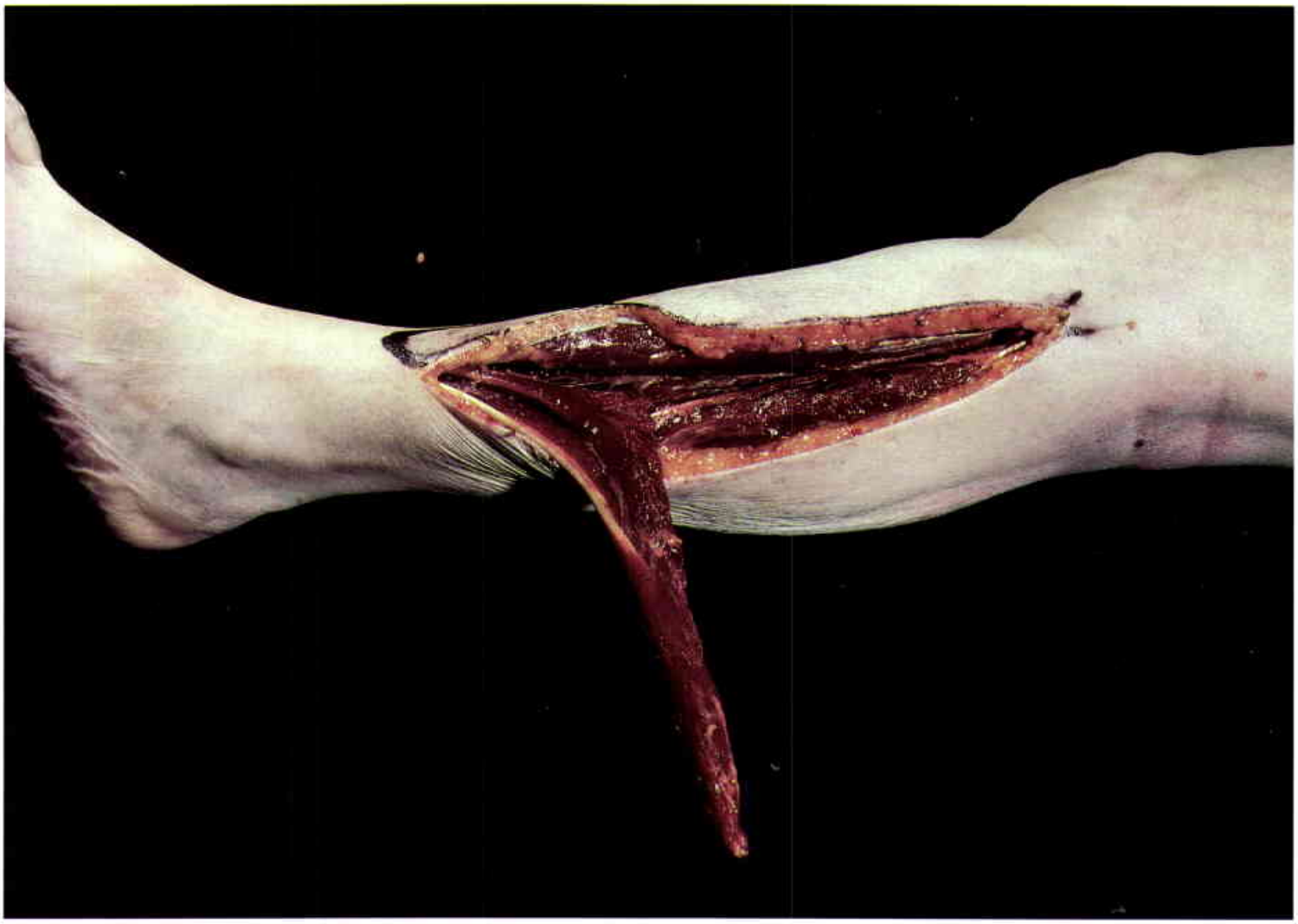
COMPLICATIONS, PITFALLS, AND DONOR SITE

The EDC muscle does not have a well-delineated fascial covering so one must be very careful not to shred the muscle during its dissection. It is not clear exactly how many of the distal perforating vessels are necessary for the viability of this muscle flap, but one can safely take the proximal 30 to 40% of these vessels without harming the survival of the "reversed" muscle flap. If there is a question about the need to include certain deep perforators, microvascular clips can be placed on the suspect vessels, the muscle can be fluoresced, and then the muscle bleeding can be observed. If there is still a quandary, one can transpose the muscle and wait two to three days to excise any area of questionable viability. Skin grafting should preferably be completed in a delayed fashion.

The functional deficit from the use of the EDC muscle is not terribly significant if the extensor tendons are tenodesed. Only the fifth toe lacks an accessory short toe extensor. Since the primarily closed donor site is favorable, the known functional loss is a small price to pay for a healthy muscle flap transfer to these difficult pretibial defects of the lower leg. Presently the EDC muscle flap has a limited but very significant application. However, its usefulness may become less important as microvascular transfers become more effective.



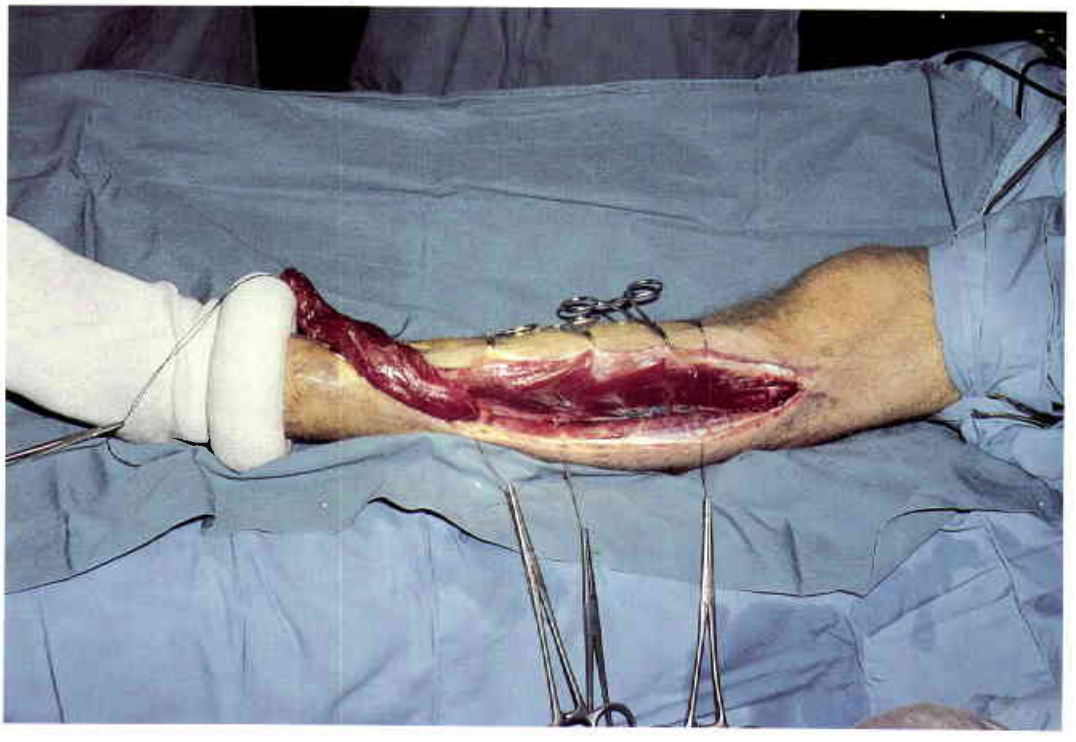
1
Outlined incision and a typical area of coverage for a distally based EDC muscle flap.



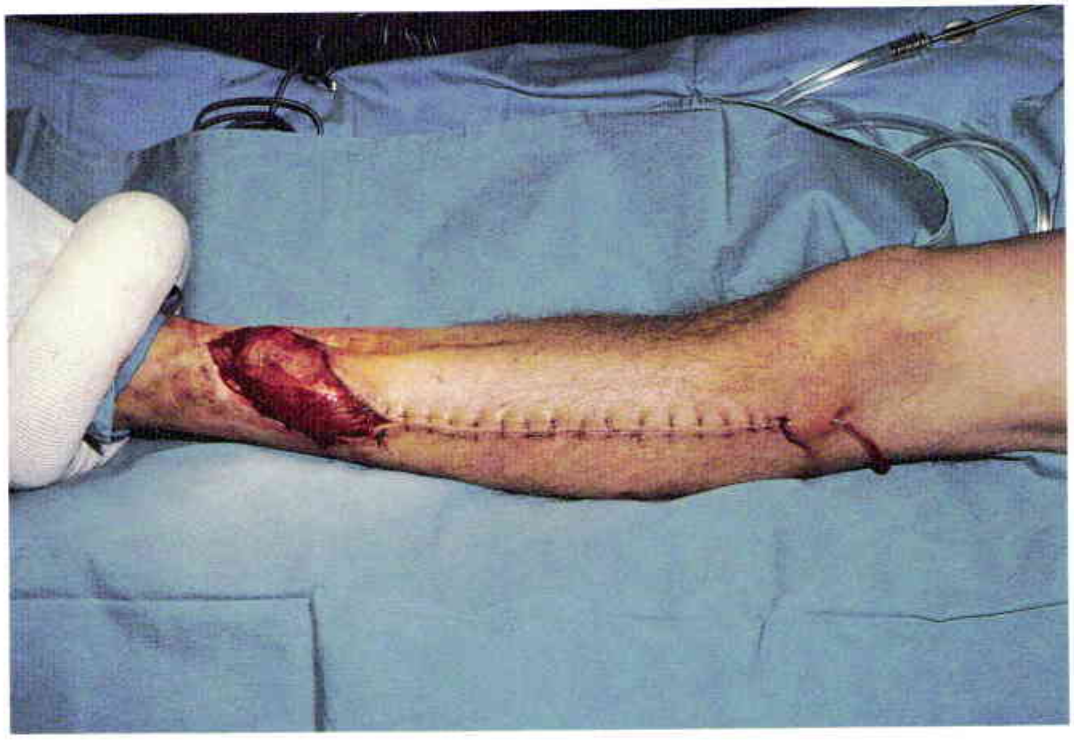
2
Multiple deep perforating vessels are seen entering the distal EDC muscle from the anterior tibial vessels.

3
The EDC muscle is rotated distally to demonstrate the expected coverage for a lower pretibial defect. It does not reach the ankle joint nor the malleoli.

4
Twenty-seven-year-old male three years following an open fracture of the lower tibia. The osteomyelitic defect was small but the bone had been actively infected since the time of injury. The incision for the retrieval of the EDC muscle is outlined. (Case of P.G. Arnold)

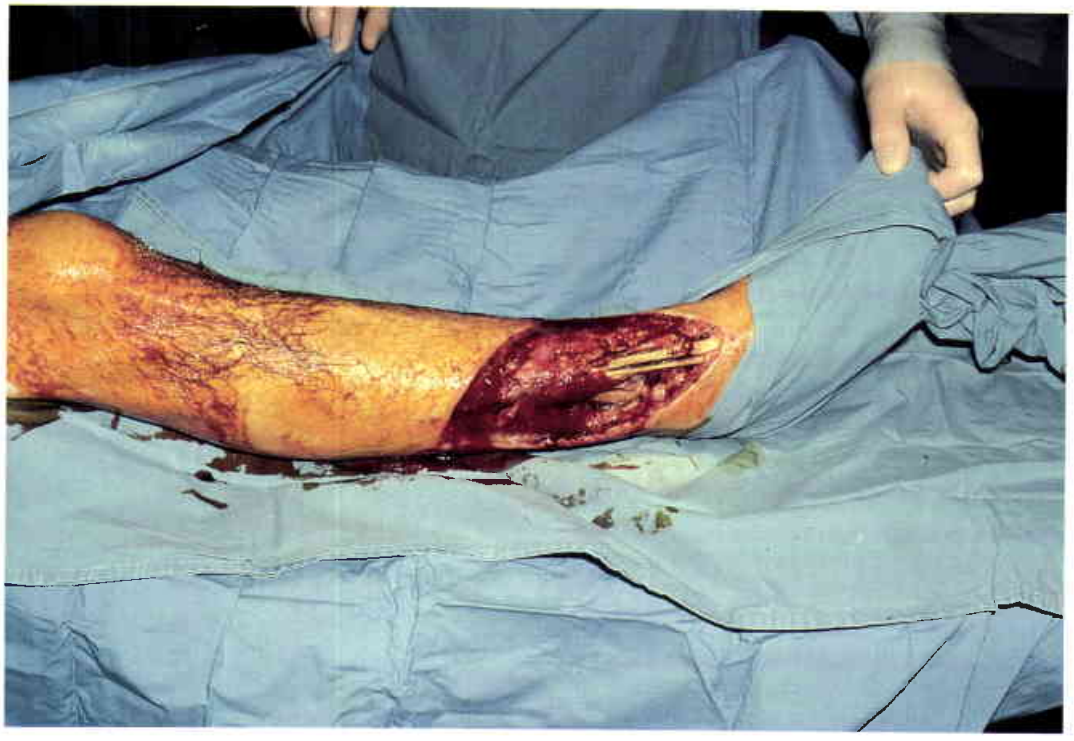


5
A "reversed" EDC muscle flap is transposed. The viable portion of the muscle flap extends well past the tibial defect.

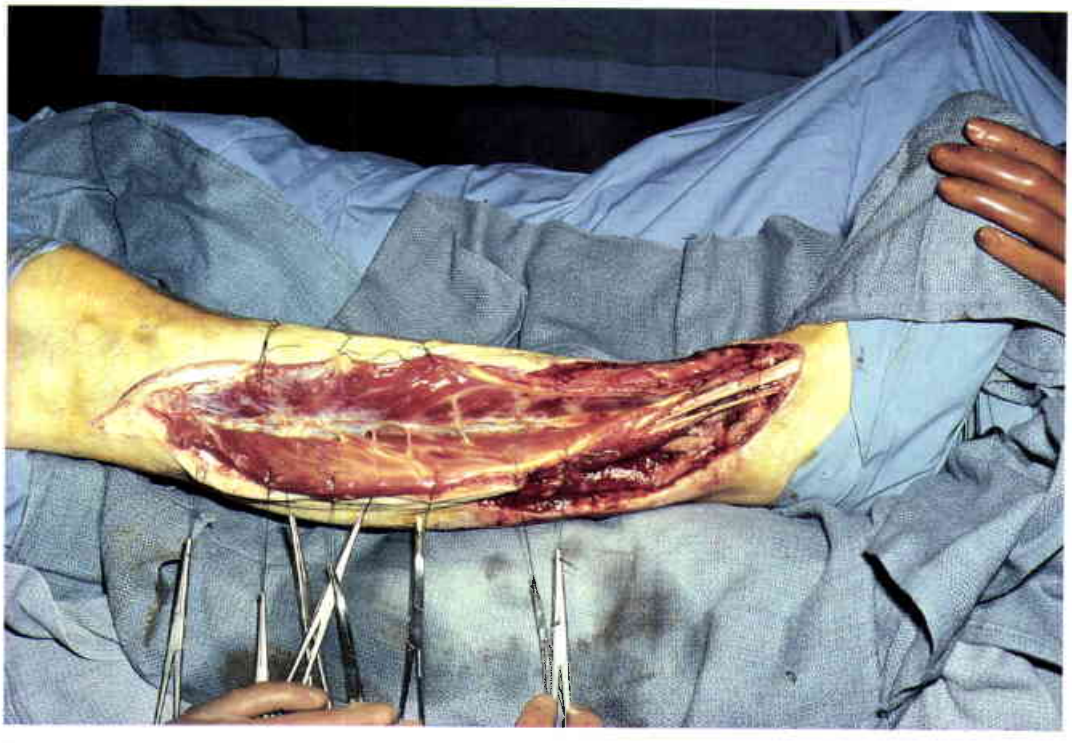


6
Appearance of the inset EDC muscle flap and the donor site closure. Grafting was delayed for forty-eight hours.

7
Appearance six years following the muscle flap closure. The wound has remained soundly healed and free of drainage.



8
Twenty-three-year-old man with a grain auger injury, which exposed the anterior compartment. A distal fibular fracture is acutely infected. (Case of P.G. Arnold)

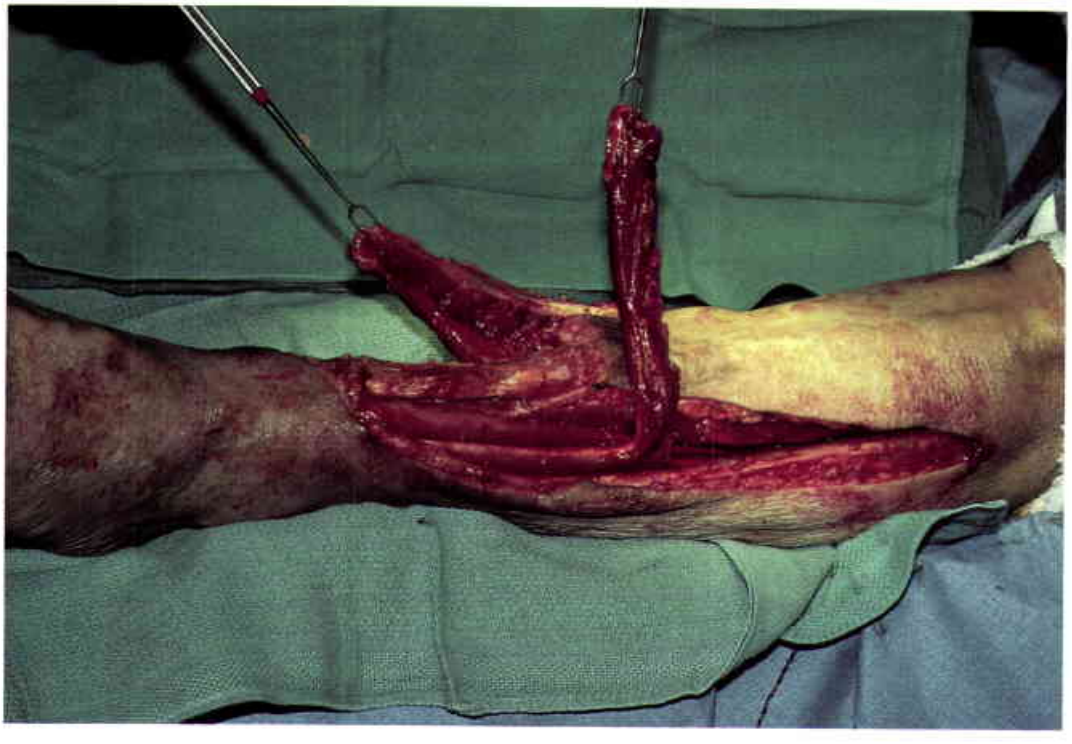


9
The extensor digitorum communis muscle is partially elevated. The multiple perforating vessels from the tibialis anterior vasculature are demonstrated between the retracted EDC muscle and the tibialis anterior muscle.

10
The extensor digitorum communis muscle is mobilized on the distal one-third of the perforating vessels.

11
Healed wound approximately six weeks later. The fibular fracture healed, and the osteomyelitis has not recurred over a six year period.

12
Skin loss of the anterior and medial calf following a Linton procedure for venous hypertensive disease. The patient had previously undergone more than twenty skin grafting procedures. She was strongly advised to have a very high below-knee amputation. (Case of J.B. McCraw)

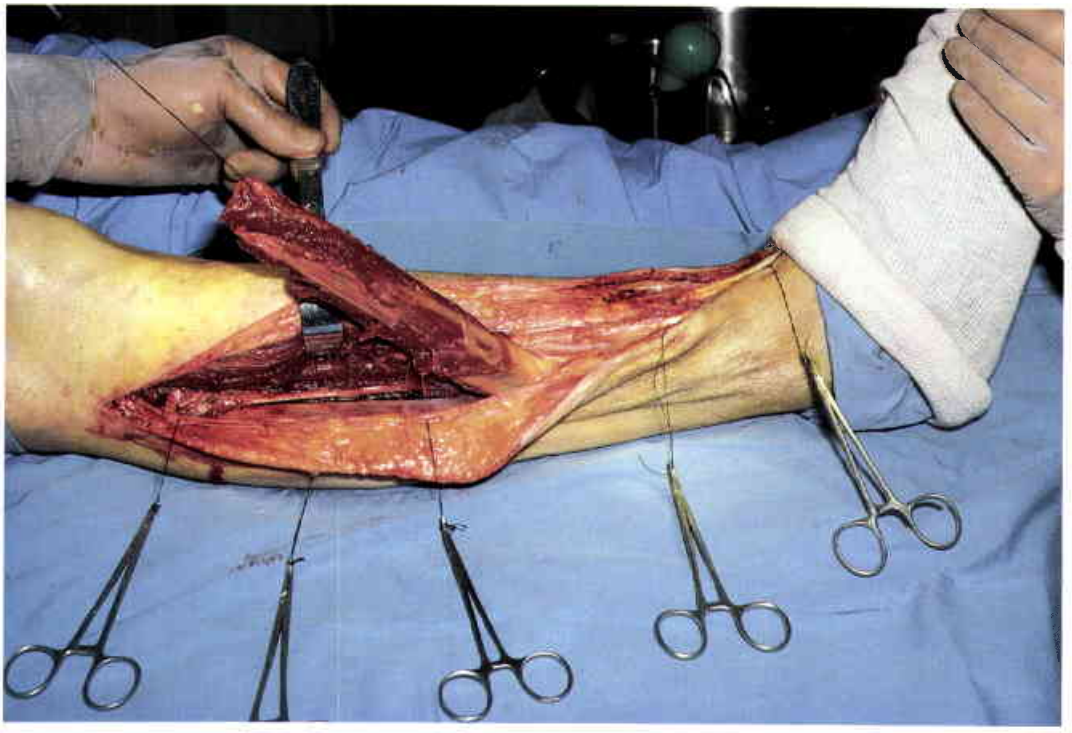


13
The wound was widely excised to remove all incompetent venous perforators. A proximally based soleus muscle flap is elevated medially, and a "reversed" EDC muscle flap is elevated laterally.

14
The soleus and EDC muscle flaps were approximated at the medial border of the tibia. Note that the "reversed" EDC muscle flap completely covers the distal tibia.

15
The split thickness skin grafts of the proximal soleus and distal EDC muscle flaps have remained healed for eight years.

16
Extensive tibial osteomyelitic defect in a fifty-six-year-old man. The tibia is stable, but the infection has been progressive over a five year period. A sequestrectomy had been done forty-eight hours earlier. (Case of P.G. Arnold)



17
"Reversed" EDC muscle flap elevated. Note the large size of the retracted muscle.

18
The tibial defect was completely obliterated by the EDC muscle flap. The EDC tendons were tenodesed.

19
Healed muscle flap and STG at four months. The wound has remained healed for seven years. This wound certainly could be handled with a "free" flap today, but the EDC muscle flap still provides a useful alternative.

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