

## The extensor digitorum brevis muscle flap for the reconstruction of soft tissue defects in the lower limb

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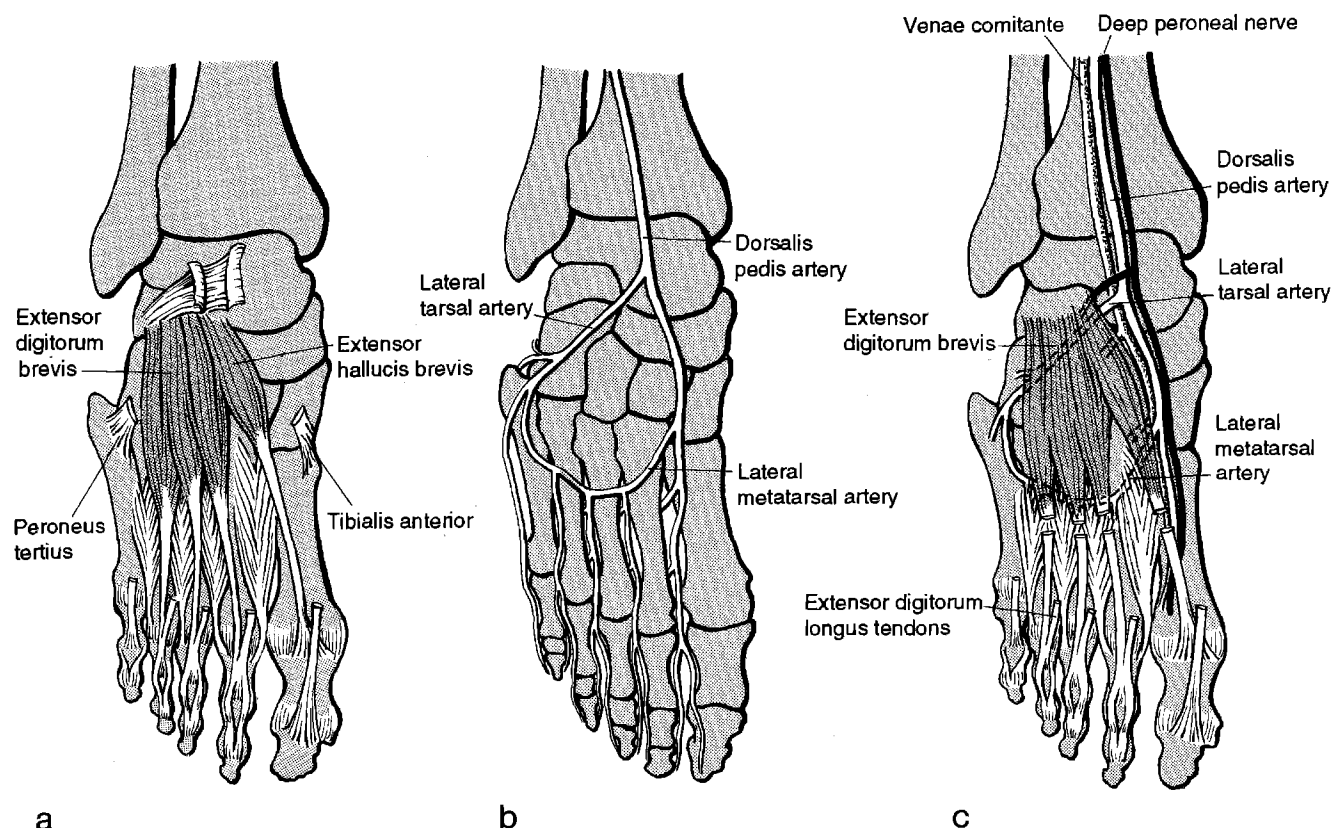
**Abstract.** The use of the extensor digitorum brevis muscle as a local muscle island flap for the cover of soft tissue defects in the lower extremity is presented. The anatomy of the muscle, the blood supply, the elevation, and use of the extensor digitorum brevis muscle flap in the lower extremity are discussed. This flap offers a mean area of 27 cm<sup>2</sup>, which can cover large skin defects otherwise difficult to treat. A case of trauma to the medial

malleolus is presented; this was treated successfully with the extensor digitorum brevis muscle flap.

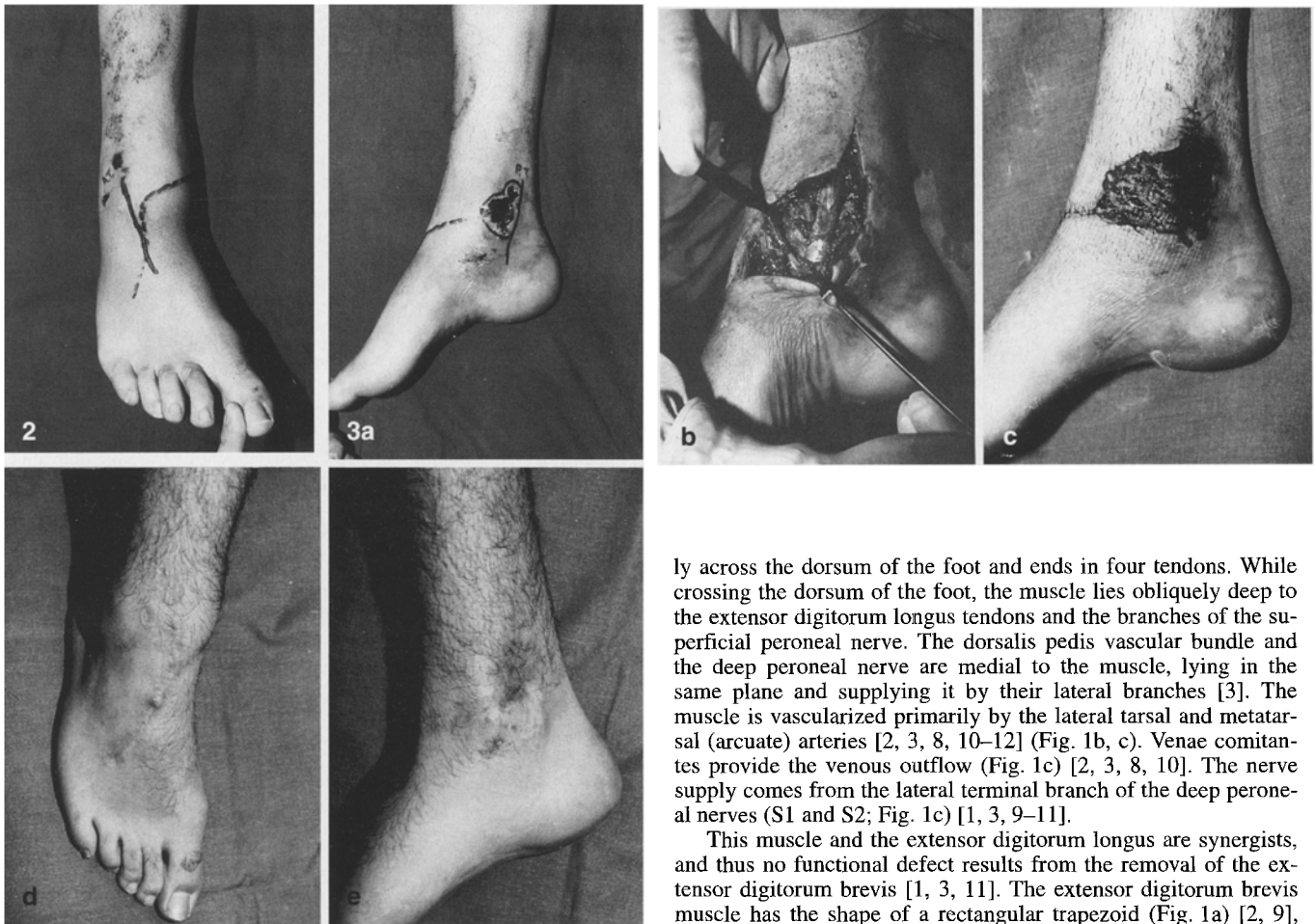
**Key words:** Lower extremity defects – Extensor digitorum brevis – Muscle flaps

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Reconstruction of soft tissue defects in the distal third of the leg is quite difficult because of the poor blood supply



**Fig. 1a–c.** Anatomy of extensor digitorum muscle flap. **a** Extensor digitorum muscle. **b** Vascular anatomy. **c** Anatomic relations, flap elevation



**Fig. 2.** Donor site incision design

**Fig. 3a–e.** Surgical procedure. **a** Skin defect, recipient site incision design. **b** Skin defect after thorough débridement. Plate and screws used for internal fixation visible. **c** Immediate postoperative result. **d** One-year postoperative (donor site). **e** One-year postoperative (recipient site)

to the skin in this area [9]; in addition, there is a lack of adequate subcutaneous and muscle tissue to cover the defect and accept skin grafts. A wide variety of methods have been described over the years. The cross-leg flap [5, 9, 19], the tubed pedicle flap [18, 21], the neurovascular skin island flap [4, 7, 20], muscle and musculocutaneous flaps, which have largely supplanted the standard cross-leg flap, and the dorsalis pedis flap [15]. In 1979 Mathes and Nahai [11] introduced the extensor digitorum brevis muscle flap, which was further described in 1985 [9, 10].

This paper, describes the use of the extensor digitorum brevis flap to a skin defect in the medial malleolar region.

## Materials and methods

### Anatomy

The Extensor Digitorum Brevis is the only muscle on the dorsum of the foot [1, 3] (Fig. 1a). It passes obliquely distally and medial-

ly across the dorsum of the foot and ends in four tendons. While crossing the dorsum of the foot, the muscle lies obliquely deep to the extensor digitorum longus tendons and the branches of the superficial peroneal nerve. The dorsalis pedis vascular bundle and the deep peroneal nerve are medial to the muscle, lying in the same plane and supplying it by their lateral branches [3]. The muscle is vascularized primarily by the lateral tarsal and metatarsal (arcuate) arteries [2, 3, 8, 10–12] (Fig. 1b, c). Venae comitantes provide the venous outflow (Fig. 1c) [2, 3, 8, 10]. The nerve supply comes from the lateral terminal branch of the deep peroneal nerves (S1 and S2; Fig. 1c) [1, 3, 9–11].

This muscle and the extensor digitorum longus are synergists, and thus no functional defect results from the removal of the extensor digitorum brevis [1, 3, 11]. The extensor digitorum brevis muscle has the shape of a rectangular trapezoid (Fig. 1a) [2, 9], and in the adult the four slips measure about 4.5×6.0 cm, thus offering a mean resurfacing area of 27 cm<sup>2</sup> (range 19–34 cm<sup>2</sup>) [2, 3, 9, 10].

### Surgical technique

The operation is carried out under general anesthesia with a tourniquet on the thigh [2, 3, 8]. Exposure of the extensor digitorum brevis is obtained through an incision shown in Fig. 2 [10, 13]. The tendons of the extensor digitorum longus are dissected off the underlying slips of the extensor digitorum brevis [8–11] and cut at the level of the distal third of the metatarsal bones [9]. The dorsalis pedis artery and venae comitantes (dorsalis pedis vascular bundle) are divided distal to the lateral tarsal artery at the level where the muscle bellies of the extensor digitorum brevis become tendinous. The flap is elevated from distal to proximal [2, 10], rotated through a deep subcutaneous tunnel underneath the tendons [9], and then transposed and inset into the recipient site [10]. A meshed split-thickness skin graft covers the muscle immediately or after 48 h [9, 13]. The donor site incision is closed primarily [2].

### Case report

A 25-year-old man was involved in a motorcycle accident and sustained a medial malleolar fracture which was stabilized with a plate and screws. Eventually the overlying skin necrosed, and the plate was exposed (Fig. 3a). The wound was thoroughly debrided (Fig. 3b), and the skin defect was covered using an extensor digitorum brevis muscle flap and a meshed split-thickness skin graft

(Fig. 3c). At 2-year follow-up no problems had arisen, and the patient showed an excellent functional and aesthetic result (Fig. 3d, e).

## Discussion

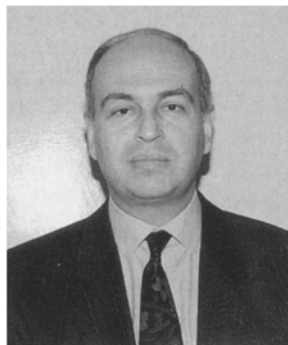
Soft tissue defects of the lower third of the leg and ankle continue to be among the most difficult areas to reconstruct [2]. The extensor digitorum brevis muscle flap has proven particularly useful in reconstruction of the lower extremity and especially around the malleoli and the calcaneum [3]. It has a good and dependable vascular supply [3], and few anatomical variations have been described [3,9]. The extensor digitorum brevis muscle flap has the following advantages over the alternative options [3]:

- It is a one-stage procedure and does not require the use of the other extremity [10].
  - It is a reliable flap because it is based on a large artery with few anatomical variations [3].
  - The donor site deformity is limited to the necessary scar needed to approach and rotate the muscle [3], and the dorsal foot skin is closed primarily [10].
  - The flap is well-vascularized muscle tissue for cover of bone or joint, and the procedure is technically easy [3, 9, 10].
  - It has a wide arc of rotation solving many problems in the area [3, 9, 10].
  - The surface of the flap allows cover of defects up to 30 cm<sup>2</sup> [3, 9, 10].
  - It is far more pliable than musculocutaneous flaps [16].
  - The good arterial inflow gives this muscle flap biological properties which are advantageous in dealing with local infections [3, 6, 14].
  - The weight-bearing plantar aspect of the foot and the skin over the heel are not incised, as is the case with the flexor digitorum brevis muscle island flap [10].
- The disadvantages are:

- For muscle flaps covered with skin graft, sensation is diminished if the muscle remains innervated; it is limited to pressure sensitivity transmitted through the underlying muscle [16].
- The use of this flap changes the foot into a one-vessel limb, with its possible complications [2].

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