

36 Radial Forearm Fasciocutaneous Flaps

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◆ Classification

- Type C fasciocutaneous flap

◆ Vascular Pedicle

The radial forearm flap encompasses all of the skin covering the entire forearm. The brachial artery bifurcates into the radial and ulnar arteries at the elbow crease. The radial artery courses between the brachioradialis and the pronator teres in the upper forearm and lies in the lateral intermuscular septum between the flexor carpi radialis and the brachioradialis in the lower forearm. Septocutaneous perforators supply the overlying skin in the proximal forearm and direct cutaneous perforators from the radial artery supply the overlying skin in the distal forearm. The radial artery continues under the

abductor pollicis longus and extensor pollicis brevis tendons as the deep palmar arch where it joins up with the ulnar artery (**Fig. 36.1**).

The radial forearm flap is drained by a superficial venous system and a deep venous system. The superficial system is drained by the cephalic vein, which courses on the radial border of the flap to join the basilic vein. This can be included to improve venous drainage of the flap. The deep system is usually based on the two accompanying venae comitantes to the radial artery. This is especially crucial in distally based flaps.

- Mean arterial caliber: 1.5 to 2.0 mm
- Mean venous caliber: 1.0 to 1.5 mm; cephalic vein: 1.5 to 2.0 mm
- Length: 20 cm
- Sensory innervation: Lateral antebrachial cutaneous nerve (radial half of flap), medial antebrachial cutaneous flap (ulnar half of flap)

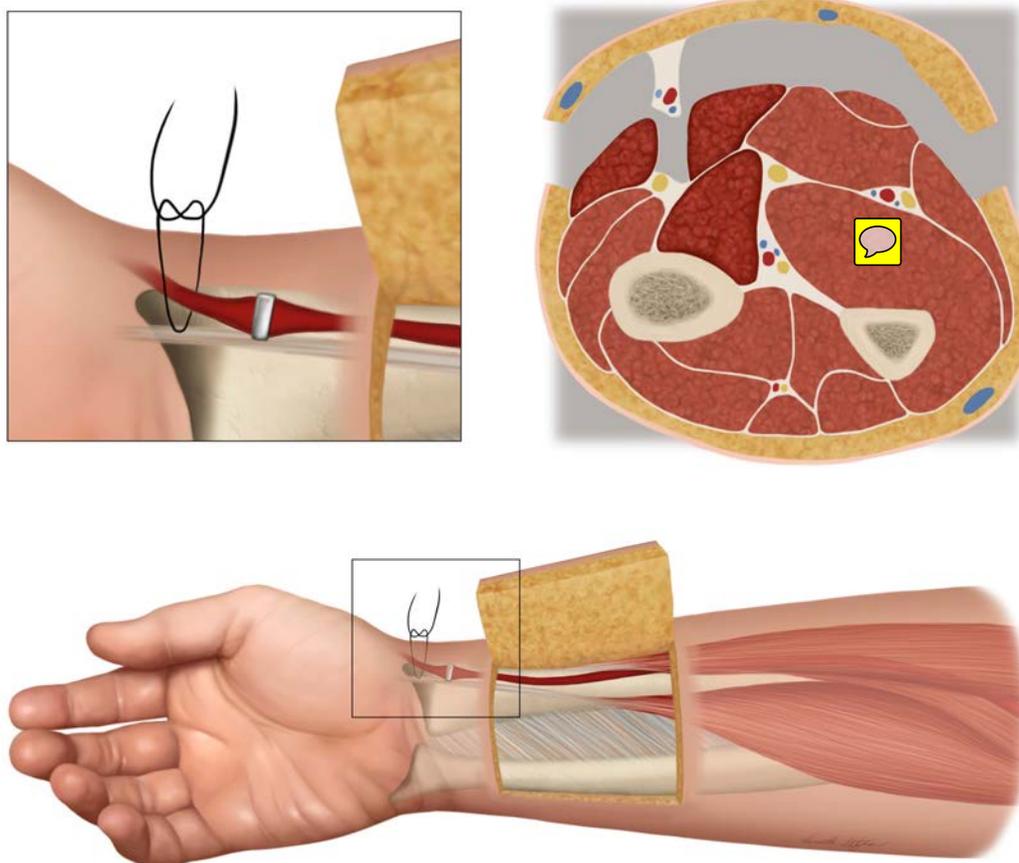


Fig. 36.1 Blood supply to the radial forearm flap. The radial forearm flap is supplied by septocutaneous perforators from the radial artery in the distal forearm.

◆ Patient Positioning

The patient is positioned in the supine position with the arm extended and supinated on an arm board. A sterile tourniquet is placed in the upper arm.

◆ Surface Markings

1. Mark the proximal wrist crease to determine the distal extent of the flap.
2. Mark the radial and ulnar borders to determine the width of the skin paddle.
3. Mark the superficial cephalic vein and the superficial veins of the hand.
4. Mark the radial artery which can be palpated just lateral to the flexor carpi radialis (FCR) (**Fig. 36.2**).

◆ Raising the Flap

Step 1: Skin Markings

Preoperatively, the Allen's test is performed to ensure adequate collateral supply to the hand via the ulnar artery. The radial

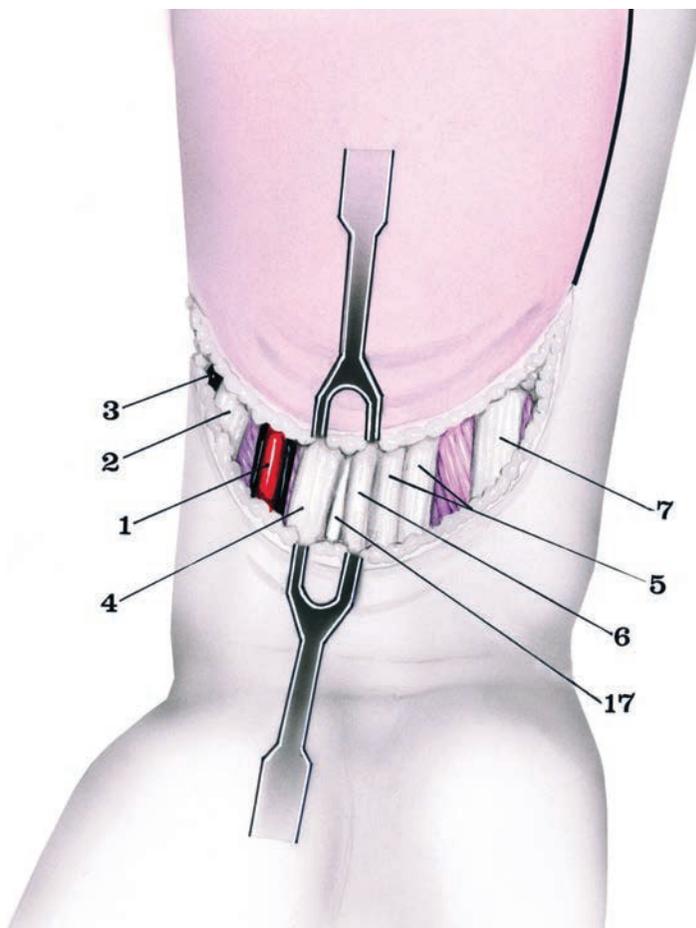


Fig. 36.2 Distal dissection of the radial forearm flap. The radial artery lies between the brachioradialis and the flexor carpi ulnaris. 1, Radial artery and its venae comitantes; 2, brachioradialis muscle; 3, cephalic vein; 4, flexor carpi radialis muscle; 5, flexor digitorum superficialis muscle; 6, palmaris longus muscle; 7, flexor carpi ulnaris muscle; 17, median nerve.¹

artery is palpated and marked along with the cephalic vein. The needed dimensions of the flap are drawn (**Fig. 36.3**).

Step 2: Skin Incision and Suprafascial Flap Harvest

The skin and dermis is incised over the planned skin markings, beginning with the ulnar border. The flap is raised in the suprafascial plane until the radial border of the flexor carpi radialis (FCR) is reached. Further dissection is deferred until the radial artery is secured distally.

The radial border of the flap is then incised (**Fig. 36.4**). Dissection is performed initially with a pair of dissecting scissors to identify branches of the superficial radial nerve and the lateral antecubital nerve (*arrowheads*), which are located above the deep fascia. The cephalic vein is also identified and preserved. The dissection is performed in the suprafascial plane medially until the brachioradialis (BR) tendon (*arrow*) is reached.

Step 3: Securing the Distal End of the Radial Artery Pedicle

The distal incision, along the proximal wrist crease, is made down to the deep fascia (**Fig. 36.5**). The superficial veins are ligated. The radial artery and the venae comitantes (*arrowheads*) are found immediately below the fascia. It is mobilized circumferentially and then ligated. The distal pedicle of the radial forearm is sutured to the distal edge of the skin edge and used as a traction suture (**Fig. 36.6**).

Step 4: Dissecting the Radial Artery Pedicle

Gentle traction on the suture presents the inferior surface of the pedicle (*asterisk*) for bottom-up dissection (**Fig. 36.7**). The transverse fibrous bands (*arrow*) seen at the base of the tunnel is the deep layer of the deep fascia. Its attachments to the deep fascia covering the BR laterally and the FCR medially at the conjoint area (*arrowheads*) must be preserved to maintain the integrity of the facial compartments of the forearm.

The roof of the tunnel located between the pedicle and the subcutaneous tissue is the superficial layer of the deep fascia. This layer (*arrowheads*) is cut and lifted with the flap (**Fig. 36.8**).

The deep layer of the deep fascia is preserved so that it covers the FCR on the ulna side and the BR on the radial side so as to maintain proper function of the flexor tendons. There are branches from the pedicle passing through the deep layer of the deep fascia to supply the underlying bone and the underlying muscle. These are ligated with hemoclips (**Fig. 36.9**).

Preservation of the branches of the perforators to the bone enables harvesting of a segment of radial bone.

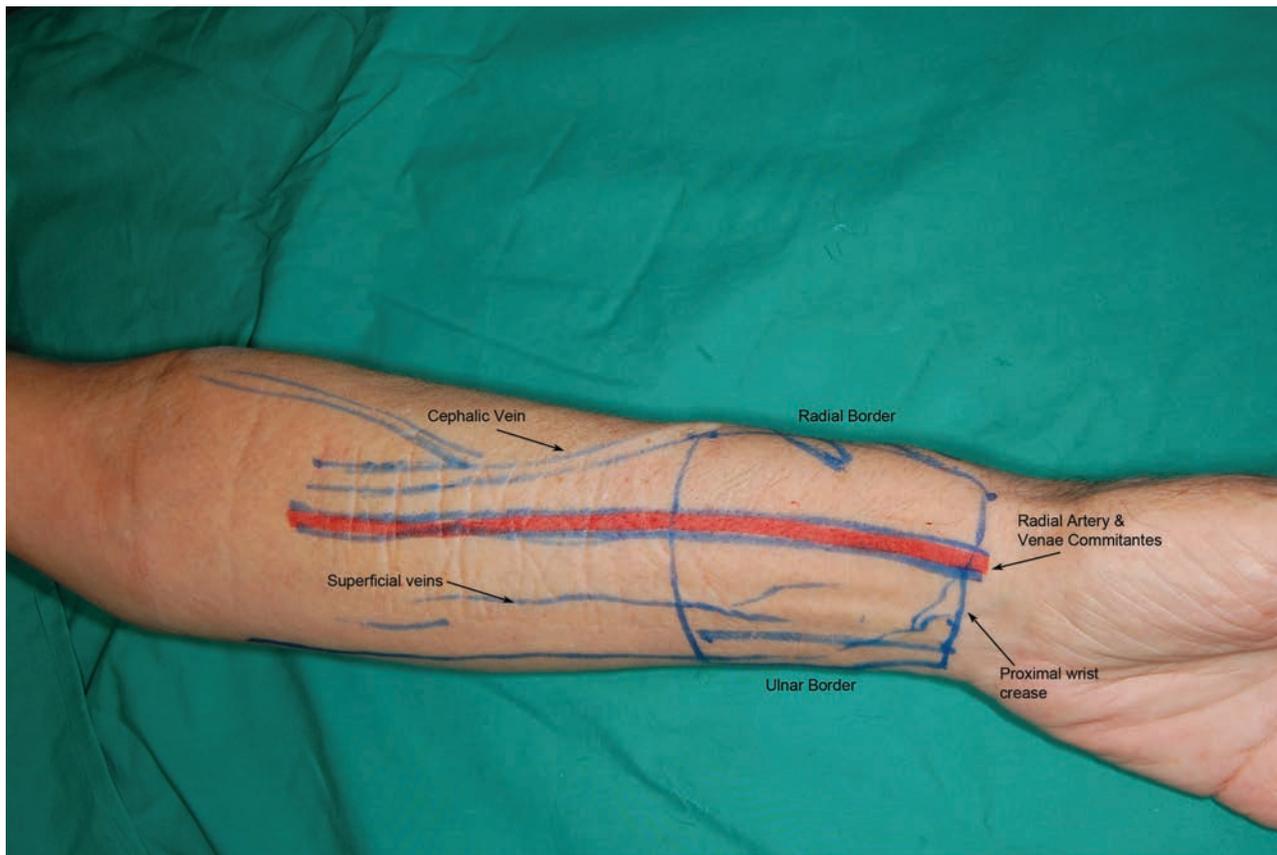


Fig. 36.3 Skin markings. The distal limit of the flap is the proximal wrist crease and the radial and ulnar borders will determine the width of the flap.²

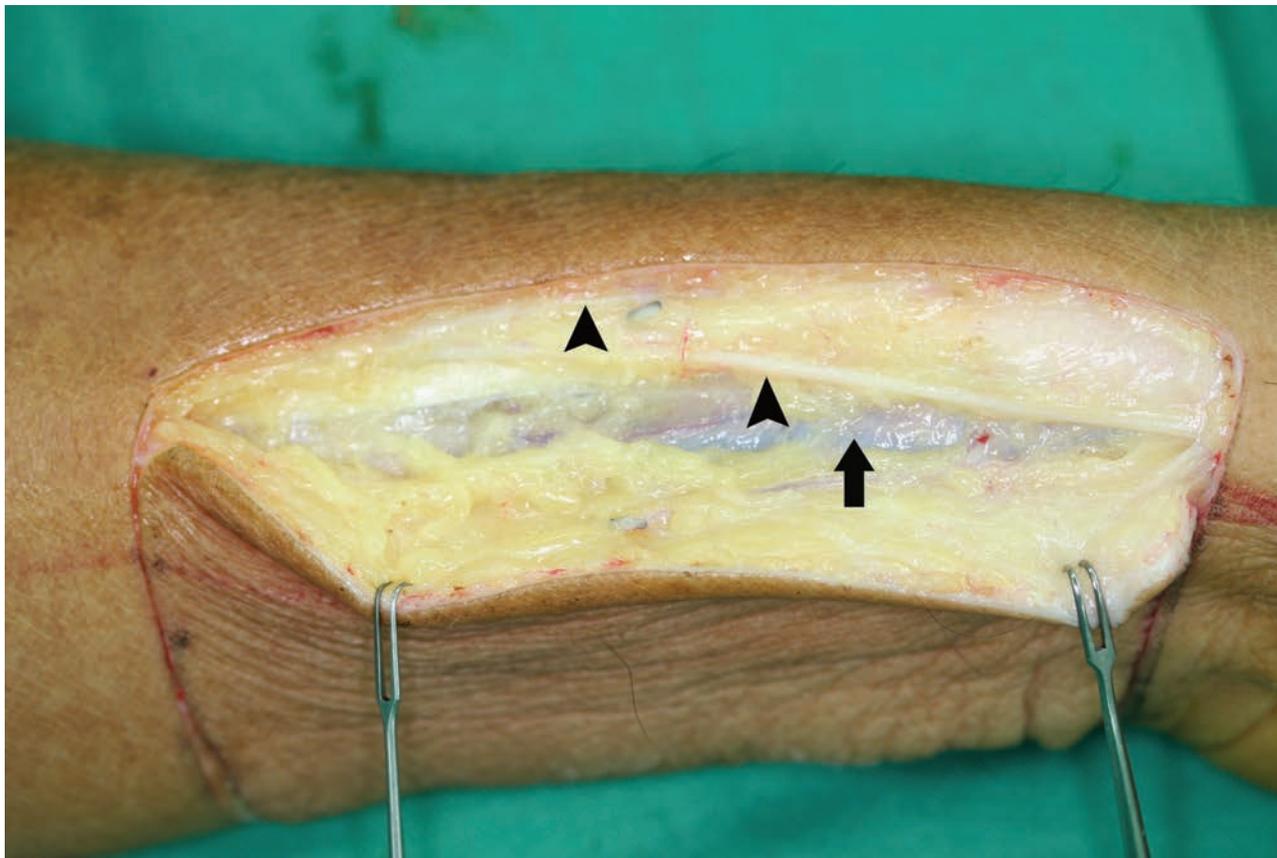


Fig. 36.4 Suprafascial flap harvest. The ulnar border of the flap is first incised (not shown here) and then the radial border is incised. The superficial radial nerve and the lateral antecubital nerve (*arrowheads*) are identified and spared. The dissection is commenced medially until the brachioradialis tendon (*arrow*) is reached.²

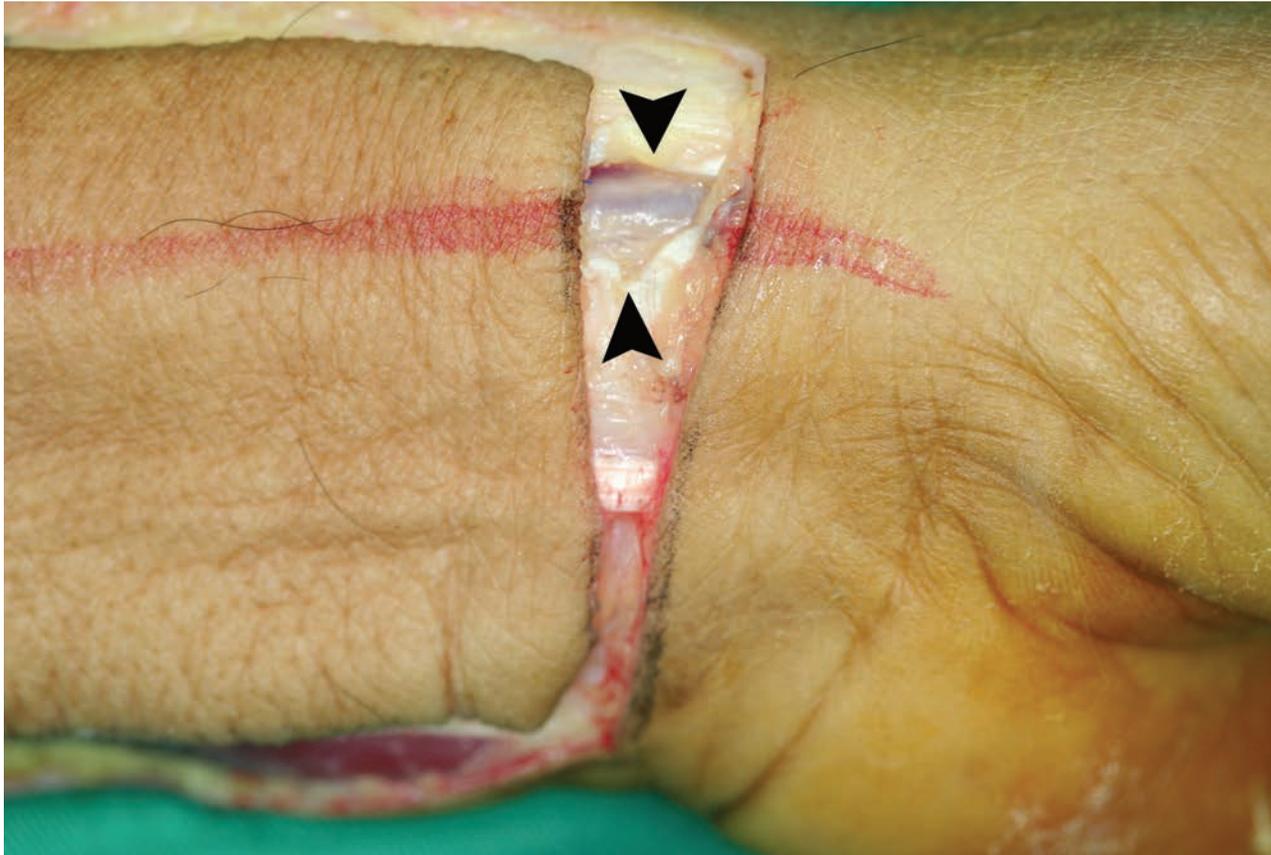


Fig. 36.5 Identification of the radial artery pedicle. The distal incision is made along the proximal wrist crease to identify the radial artery, which lies between the FCR and BR (*arrowheads*). It is mobilized circumferentially and ligated. The pedicle is sutured to the flap, such that gentle traction on the suture presents the flap for a bottom-up dissection.²

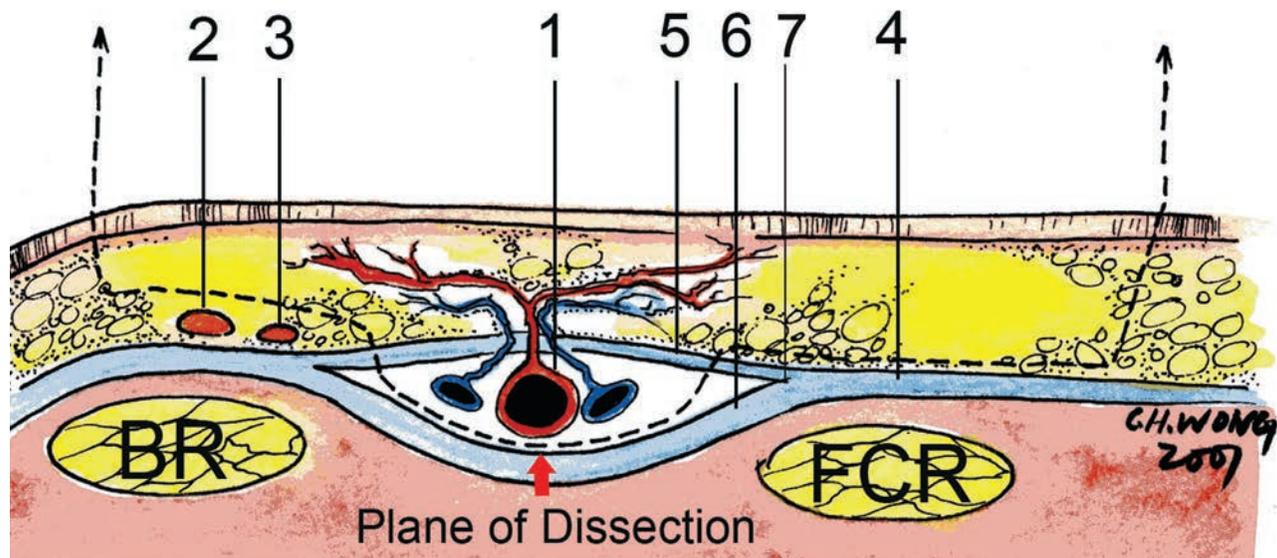


Fig. 36.6 Surgical anatomy of the distal radial artery: 1, radial artery and its venae comitantes; 2, superficial branch of the radial nerve; 3, lateral antecubital nerve; 4, deep fascia of the forearm; 5, superficial layer of the deep fascia; 6, deep layer of the deep fascia; and 7, the conjoin of the deep and superficial layer of the deep fascia. This structure must be preserved to maintain the continuity of the deep layer of the deep fascia and the fascia over the FCR and BR. This in turn is important in maintaining proper functioning of the flexor tendons and in providing a good bed for skin grafting.²



Fig. 36.7 Traction on suture for bottom-up approach. Traction on the suture ensures that the pedicle (*asterisk*) is raised with the flap and enables dissection of the flap, while preserving the deep layer of the deep fascia (*arrow*).²

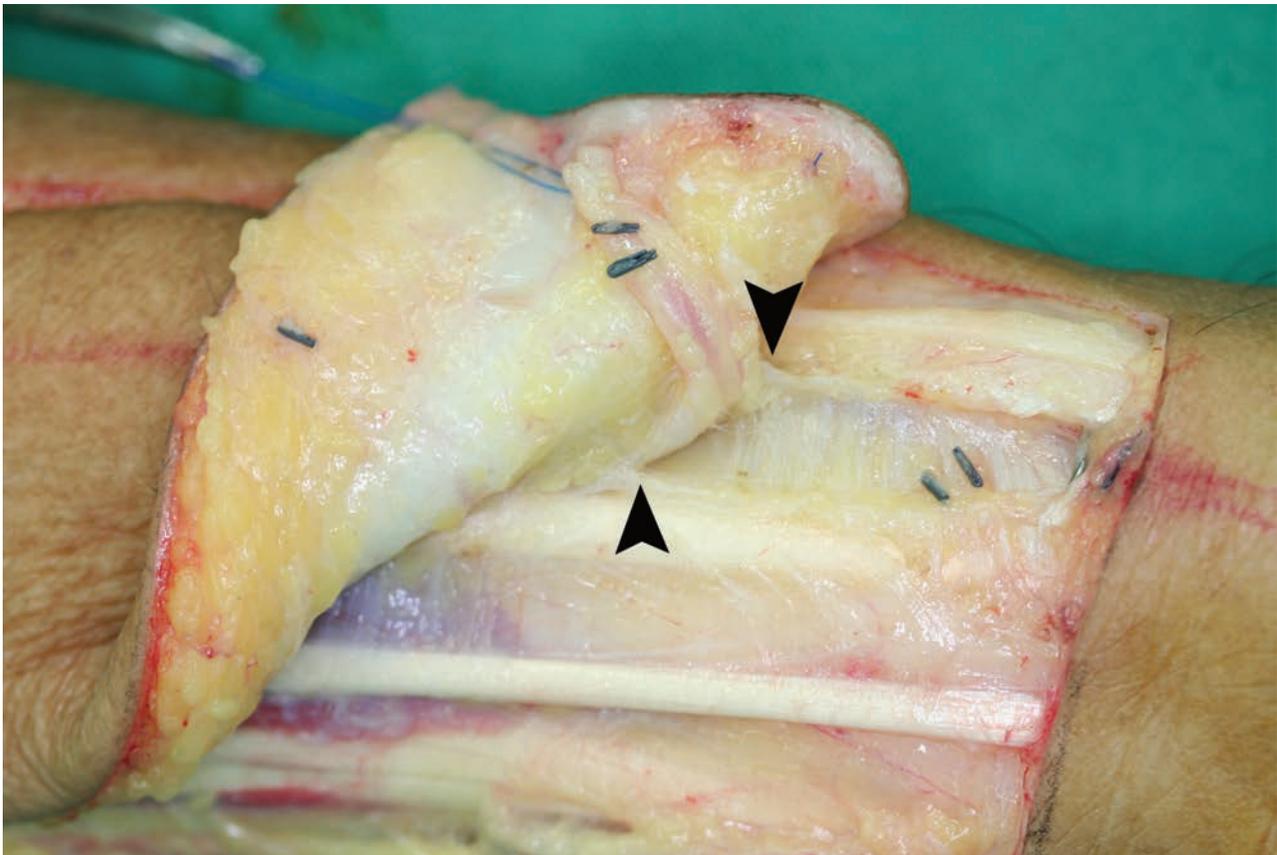


Fig. 36.8 Preservation of the deep fascia. The deep fascia covers the BR laterally and the FCR medially at the conjoined area (*arrowheads*) and must be preserved to maintain the integrity of the fascial compartments of the forearm.²



Fig. 36.9 Ligation of deep perforators to the radius. There are deep branches from the pedicles, which supply the underlying bone and muscle. These are ligated with ligaclips.²

Step 5: Proximal Dissection of the Radial Artery

Proximally, the pedicle is located in the lateral intermuscular septum between the BR and the FCR (**Fig. 36.10**). These muscles are retracted to reveal the pedicle. If a flap of a greater longitudinal dimension is required, care is taken to include the septocutaneous vessels supplying the flap proximally. The cephalic vein is also dissected proximally to a length adequate for microanastomosis (**Fig. 36.11**).

Step 6: Closure of the Donor Site

The donor site is closed with a full thickness skin graft taken from the groin (**Fig. 36.12**). The proximal forearm is closed primarily using Monocryl 3-0.

◆ Important Anatomical Structures

Identified and raised with the flap:

- Radial artery and venae comitantes
- Cephalic vein (optional)

Identified and preserved:

- Superficial radial nerve (can be included if neurotization of the skin paddle is intended)
- Lateral antecubital nerve
- Deep layer of the deep fascial overlying the FCR and BR
- Flexor carpi radialis
- Brachioradialis
- Palmaris longus (can be included if a tendon sling is required)
- Radius (40% can be included in an osteocutaneous flap)

◆ Clinical Perspectives

The radial forearm flap is a robust fasciocutaneous flap that is ideal for reconstruction of defects that require thin pliable skin. The flap can be employed as a pedicle flap that is proximally based to resurface forearm defects up to the elbow and as a distally based flap for defects up to the thumb and metacarpals. The flap can be also be harvested as a free flap for reconstruction of defects in the head and neck region and upper and lower extremities. Specialized use of the flap includes neurotization for a sensate flap. Inclusion of the perforators that supply the radius allows harvesting of an osteocutaneous flap for penile reconstruction. The palmaris longus can also be included in the flap harvest to provide a static sling.

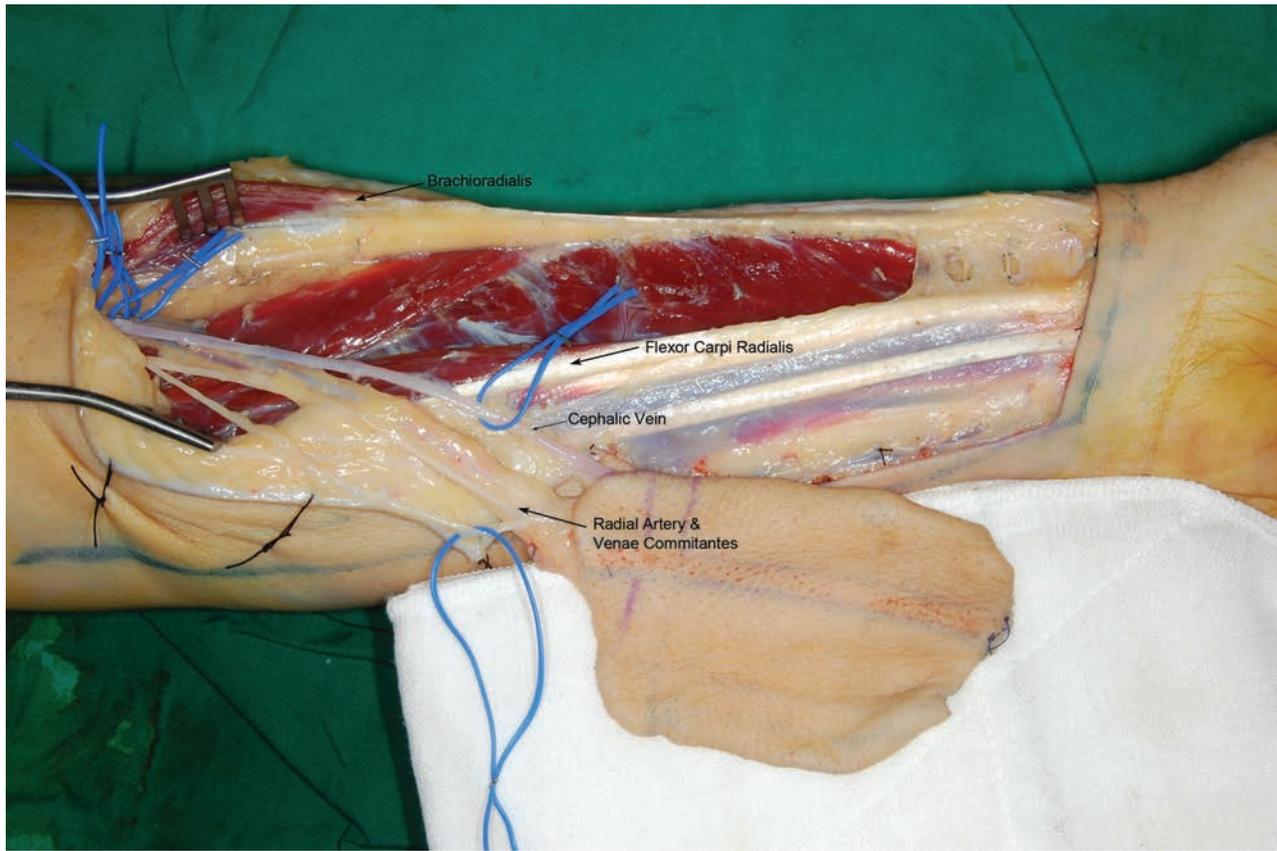


Fig. 36.10 Dissection of the proximal pedicle. The pedicle is located in the intermuscular septum between the BR and FCR. These muscles are retracted to reveal the pedicle.²

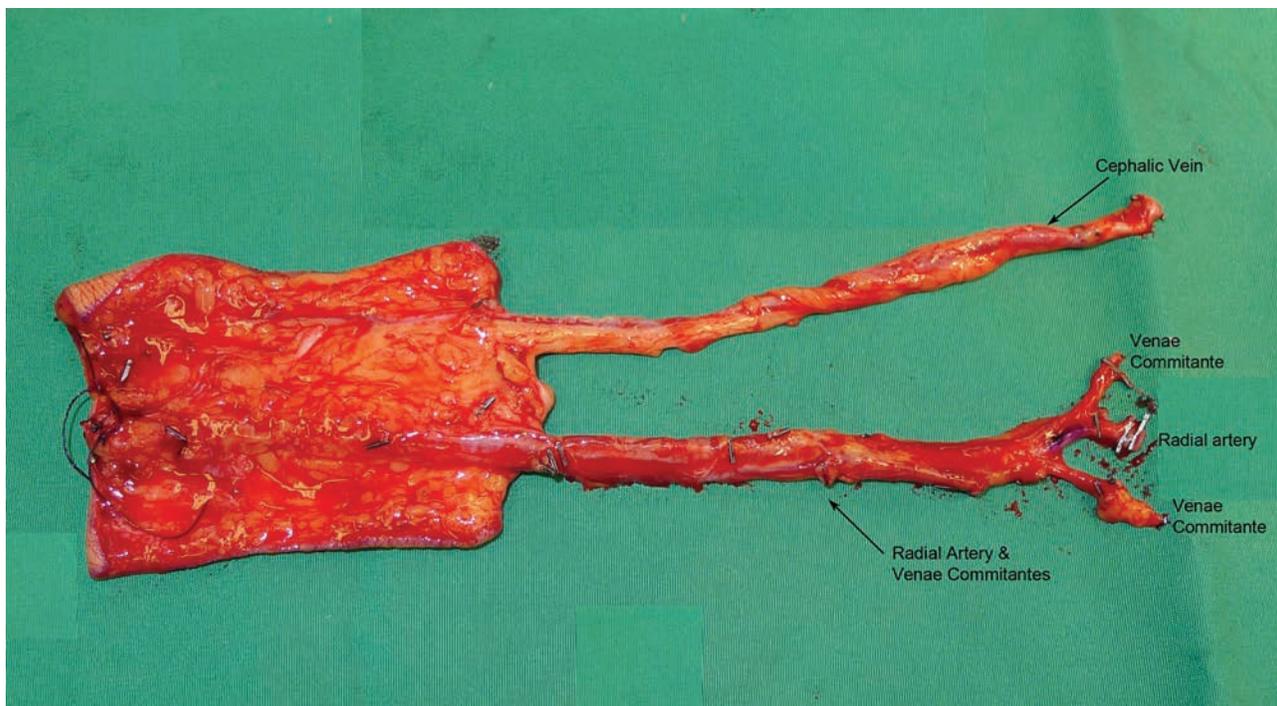


Fig. 36.11 Radial forearm flap. The cephalic vein can be included with the flap harvest to provide a separate venous drainage.



Fig. 36.12 Closure of the donor site. The donor site is closed with a full thickness skin graft taken from the groin.

◆ Radial Forearm Flap for Tongue Reconstruction

The patient is a 60-year-old man with a 2 × 3 cm squamous cell carcinoma of the left hemitongue (**Fig. 36.13a**). He underwent wide excision of the left hemitongue and reconstruction with a radial forearm free flap. The radial forearm flap was inset to reconstruct the left hemitongue.

Microanastomosis of the flap was completed under microscope assistance (**Fig. 36.13b**). The radial artery (*arrow*) was anastomosed end-to-end to the superior thyroid artery and the venae comitantes to the branch of the internal jugular vein. The cephalic vein was anastomosed to the external jugular vein.

The patient's recovery was uneventful. **Fig. 36.13c** shows the flap fully healed at 6 months and **Fig. 36.13d** shows the well-healed donor site of the left forearm.

◆ Hints and Tips

1. The **citing** of the pedicled radial forearm skin flap depends on the location of the defect to be resurfaced. For a proximal defect, the skin paddle is positioned more distally to allow an adequate arc of rotation and, for distal defects, the skin paddle is placed more proximally.
2. Placement of the flap too radially will cause the donor site to be visible when the hand is in its natural position.
3. The distally based radial forearm flap is based on retrograde perfusion through the deep palmar arch and its venae comitantes. The skin paddle is sited proximally but the surgeon has to be mindful that the perforators are fewer in the proximal forearm. As the flap is based on reverse flow of the venae comitantes, the cephalic vein should be included with the flap and anastomosed to provide extra flap drainage. There is a risk of partial flap loss due to venous congestion.
4. The flap is raised in the suprafascial plane to preserve the fascia over the tendons to reduce adhesion formation and to improve the skin graft take.
5. The radial forearm can be raised as a fascial only flap when thin fascia is required for tendon reconstruction and skin is not required.
6. The palmaris longus tendon can be harvested for reconstruction of eyelid or lip defects. Vascular connections between the radial artery and the tendons must be preserved.
7. The superficial branch of the radial nerve may be included in the flap harvest to provide a sensate flap or as a vascularized nerve flap.
8. Preservation of the branches of the perforators to the bone enables harvesting of a segment of radial bone. If the radius is harvested as vascularized bone, less than 40% of the cross section of the radius should be harvested to reduce the risk of fracture.
9. The radial forearm flap can be used as a flow-through flap where the distal vessel can be used to provide a recipient for a second free flap or to bridge segmental arterial defects.
10. Primary closure of the donor site is possible with the use of transposition flaps supplied by perforators from the ulnar artery.

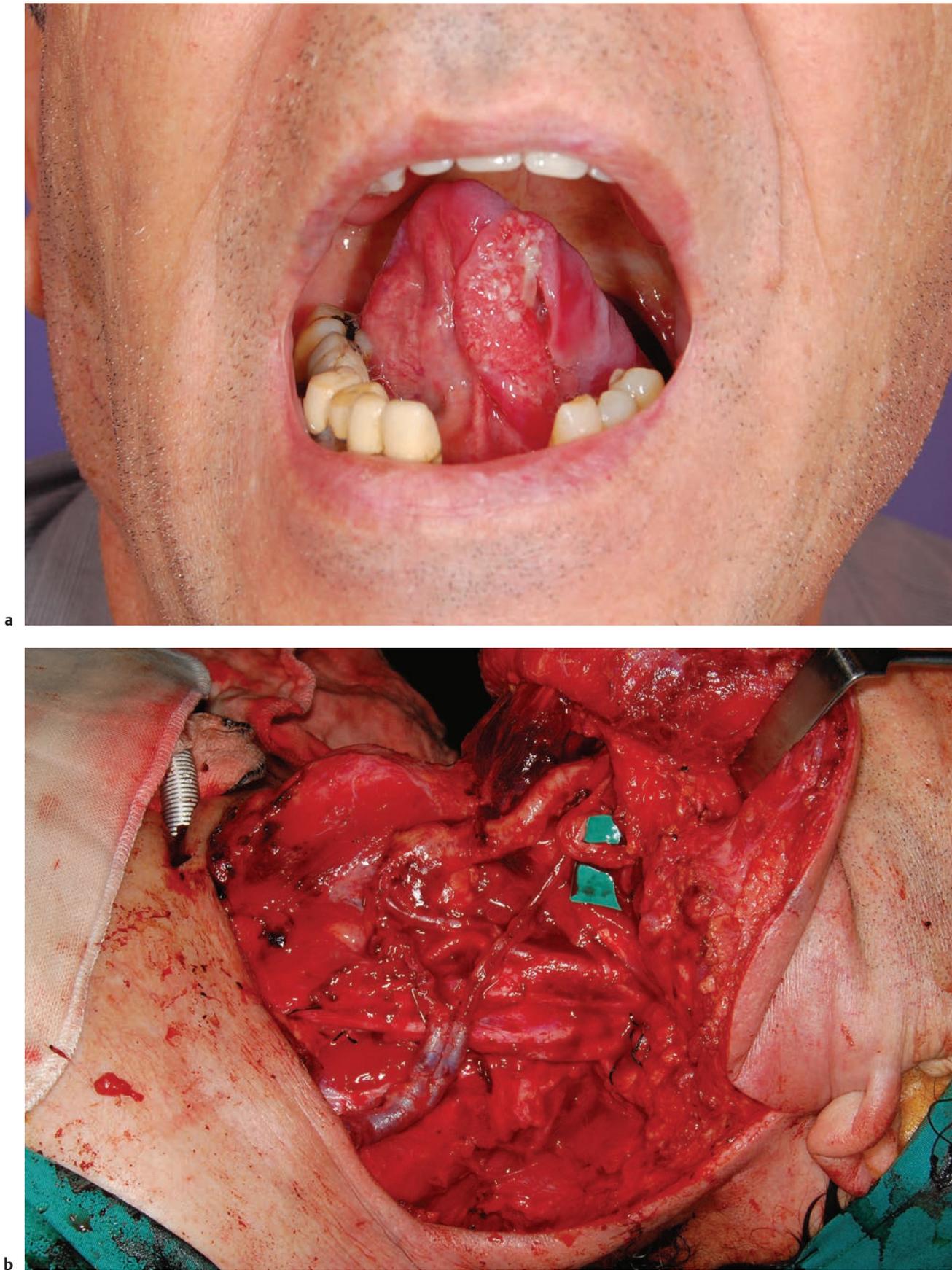


Fig. 36.13 Reconstruction of tongue. **(a)** A patient with a left tongue squamous cell carcinoma. **(b)** The microanastomosis with the radial artery anastomosed end-to-end to the superior thyroid artery. The venae are anastomosed end-to-end to a branch of the internal jugular vein and to the external jugular vein. (*continued*)



c



d

Fig. 36.13 (continued) (c) A well healed tongue reconstruction at 6 months. (d) The donor site of the left forearm.

Suggested Further Reading

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Figure Credits

1. Strauch B, Yu HL. *Atlas of Microvascular Surgery: Anatomy and Operative Approaches*. 2nd ed. New York, NY: Thieme; 2006
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