FOREARM RADIAL ARTERY FLAP. VARIATIONS

The Chinese surgeons Yang et al. originally described this flap in 1981[79], that is why it has become popularly known as the Chinese flap. The flap was later introduced into western writing by Song R et al. in 1982[73].

The radial forearm flap represented a revolution, at that time, as it was able to transfer a thin and large extension of skin, based on a single source artery; the radial artery. Amongst its advantages are:

- It is a very large and thin flap.
- It can be transferred as a free or rotational flap.
- It can be either elevated proximally or distally.

However this flap also has some major drawbacks, amongst them:

- The sacrifice of the radial artery that usually results in loosing certain strength of the forearm muscles and the hand becomes intolerant to cold temperatures.
- Profuse hairiness, that can impair aesthetic or functional results at the recipient area (i.e. penis-urethra or esophagus reconstruction)
- Extensive scars of the donor site. (skin grafts directly applied over the forearm musculature).

Due to the sacrifice of one of the two main arteries of the hand, this flap can only be proposed if the ulnar artery is fully competent. It is mandatory to perform the Allen test before proceeding with a Radial forearm flap.

The Allen test

Even flaps that do not use the main artery could challenge the vascular integrity of a previously severely injured hand. In cases where the vascularization of the hand is in doubt and before planning a flap like this, the Allen test must be performed[31] (The Allen test is mandatory in radial and ulnar flaps).

Described in 1929, the Allen test consists of the patient elevating their hand and making a fist, whilst the examiner occludes both radial and ulnar arteries. The patient extends their fingers and blanching of the hand is seen. Next, the hand is observed while the radial artery alone is released. The same manoeuvre is done with the ulnar artery. The colour of the hand should return to normal immediately after releasing one of these arteries per turn. The test is positive when the colour fails to return to normal after release of either artery.

Because of the mentioned sacrifice of the radial artery, two variations of this flap that fully preserve the main vessels, (based on perforator branches), have become

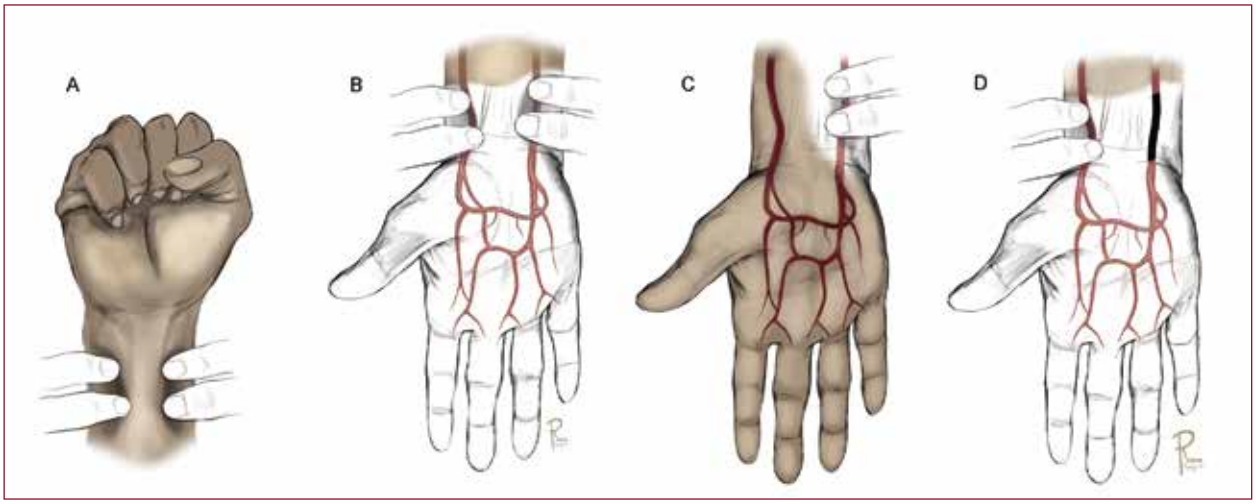

Figure 6.59. Allen Test for the patency of radial and ulnar arteries. A) Patient elevates their hand and makes a fist while examiner occludes both radial and ulnar arteries. B) Patient extends fingers and blanching of the hand is seen. C) Radial artery alone is released and the colour of the hand returns to normal. D) Pressing on the radial artery, the ulnar artery is released. If the hand remains blanched, the test is positive, and means that vascularization of the hand relies mainly on the radial artery, so it should be left untouched.

popular. So, four variations are actually in use related to the Forearm Radial flap:

- Proximally based Radial forearm flap.
- Distally based Radial forearm flap.
- Proximally based Radial artery perforator flap.
- Distally based Radial perforator flap

PROXIMALLY BASED RADIAL FOREARM FLAP

Indications

Due to the previously mentioned drawbacks, this flap is essentially used as a free flap when a large area of skin, supported by a thin subcutaneous layer, is required. As a pedicle island flap it is indicated for flat defects, affecting the elbow region.

Vascular supply

The Radial artery supplies a territory on the forearm, between the elbow and the wrist and the border of the ulna (medially), and the forearm dorsal midline (laterally). The skin is vascularized through the constant vascular subcutaneous anastomosis between three main septocutaneous branches arising from the main trunk that perforate the anterior brachial fascia. The venous return is ensured by the venae comitantes. The Cephalic vein also plays an important role, especially in distally based flaps.

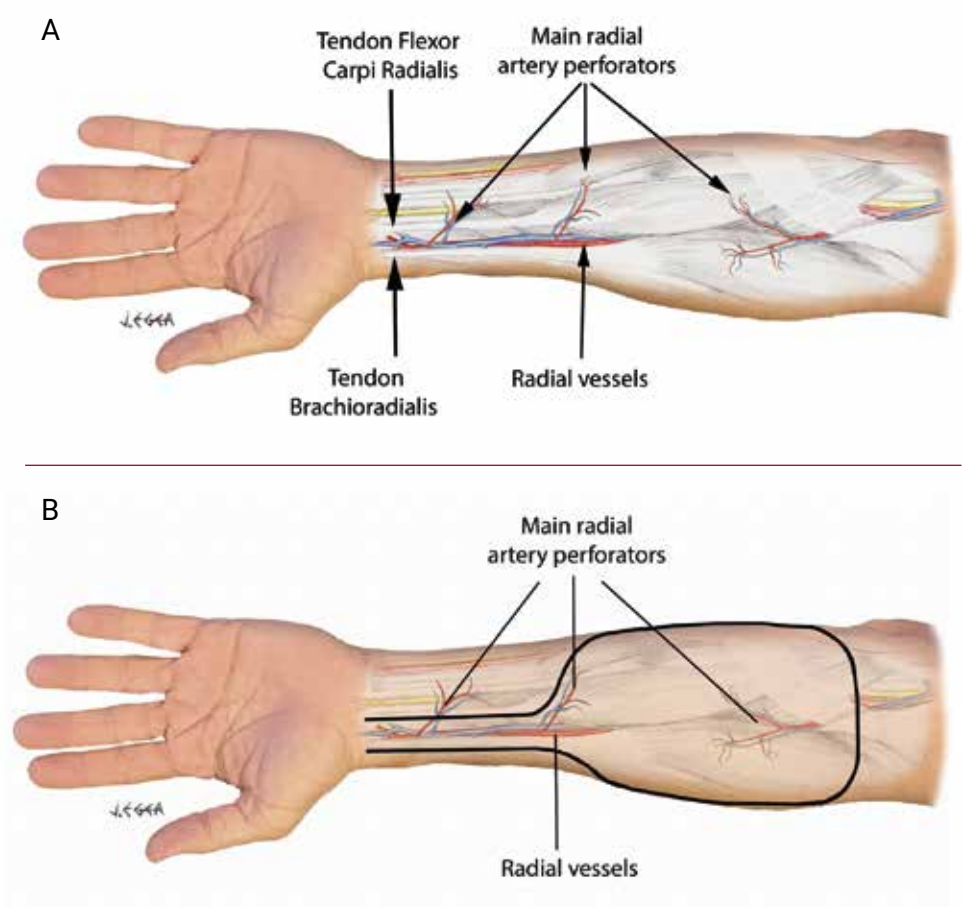

Figure 6.60. A) The radial forearm flap, proximally or distally based is vascularized by the radial artery through its perforator branches vascularizing the skin of the anterior forearm. There are three constant arteries nourishing the skin. B) Distally based radial forearm flap. The pedicle is based on the distal anastomosis of the radial artery with the ulnar artery through the carpal arches. The pedicle is localized between the tendons of the Flexor carpi radialis and brachioradialis muscles. The shorter is the pedicle the greater is the cutaneous paddle, the longer the pedicle the smaller will be the skin island.

Markings

Proximally, the radial forearm flap is designed, based on references over the wrist. With the wrist bent, the Brachioradialis tendon is identified at the lateral (radial) aspect of the wrist, while the Flexor carpi radialis tendon is seen medially. Between both tendons the Radial artery can be palpated (it is accompanied by two venae comitantes) (fig. 6.61 a). Laterally, to the brachioradialis tendon, over the lateral aspect and dorsum of the wrist, runs the superficial branches of the radial nerve and cephalic vein (fig. 6.61 b). The boundaries of the flap are the border of the ulna laterally, to the midline of the dorsal aspect of the forearm.

However, the greater the flap, the shorter the pedicle. An S-shaped or Zig-zag line is outlined on the volar aspect of the forearm, to dissect the pedicle proximally.

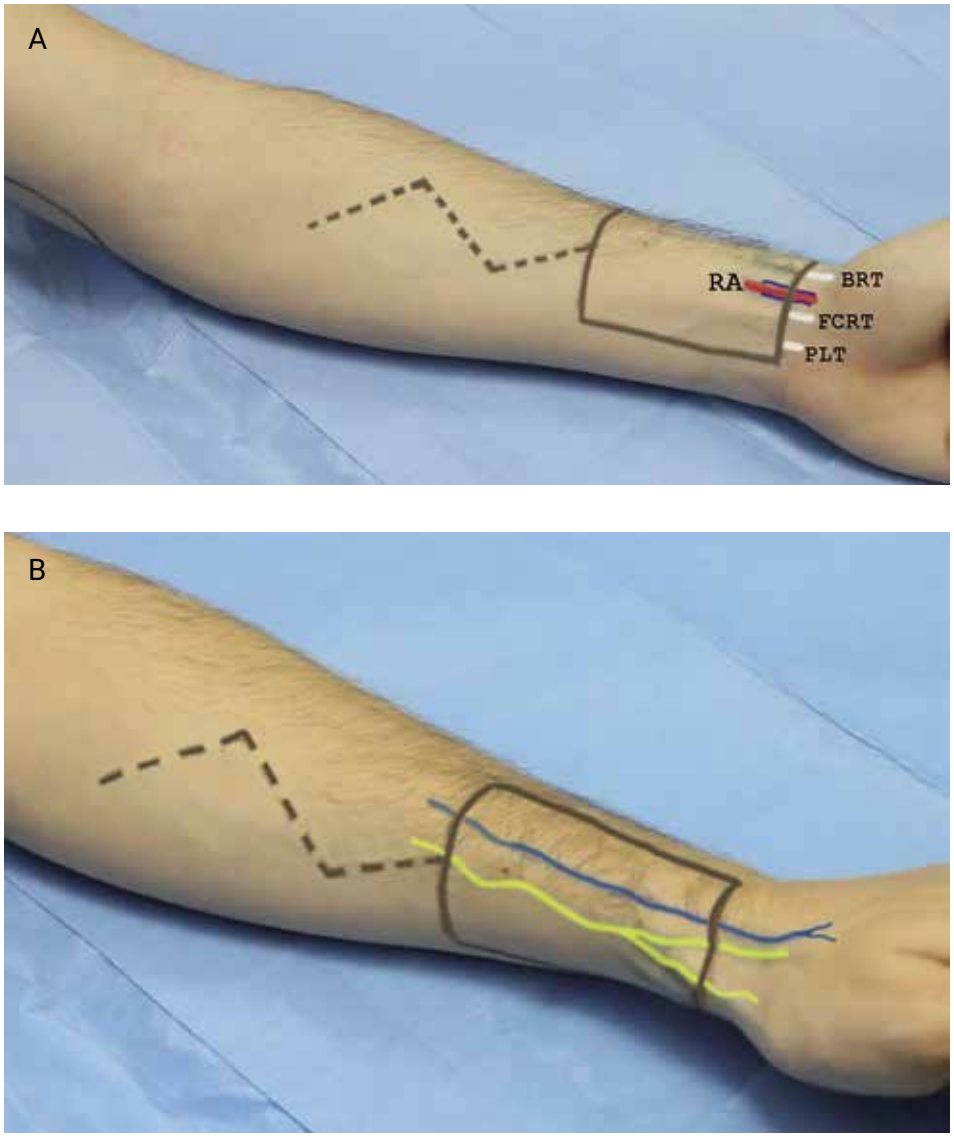

Figure 6.61. A) Anatomical references to localize the pedicle and the Radial artery: Brachioradialis Tendon (BRT), Radial artery with two vena comitantes (RA), Flexor Carpi Radialis (FCR) and Palmaris Longus (PL). B) Dorsal boundary of the flap, superficial sensitive branches of the radial nerve (yellow) and Cephalic vein in blue.

Elevation

Once the main structures on the wrist are localized, a cutaneous incision on the distal boundary of the flap is made (See legends and images below).

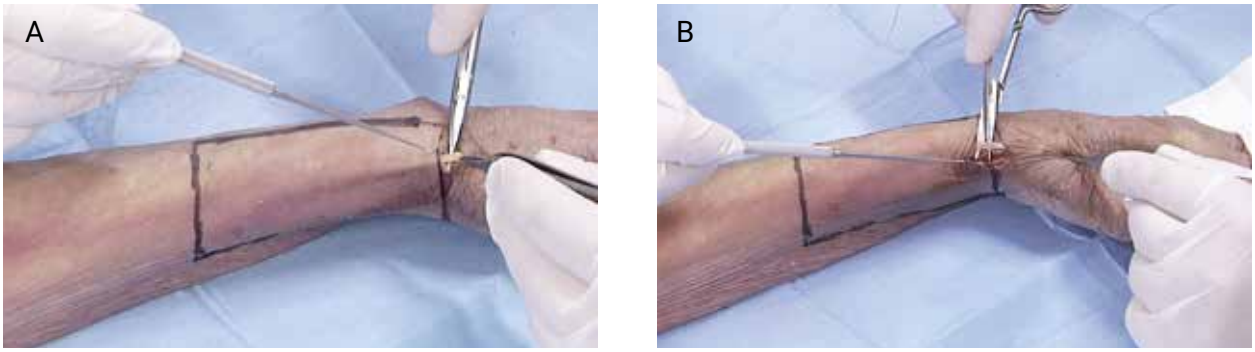

Figure 6.62. A) Cutaneous branches of the radial nerve are isolated as well as, B) the cephalic vein, that are both included into the flap.

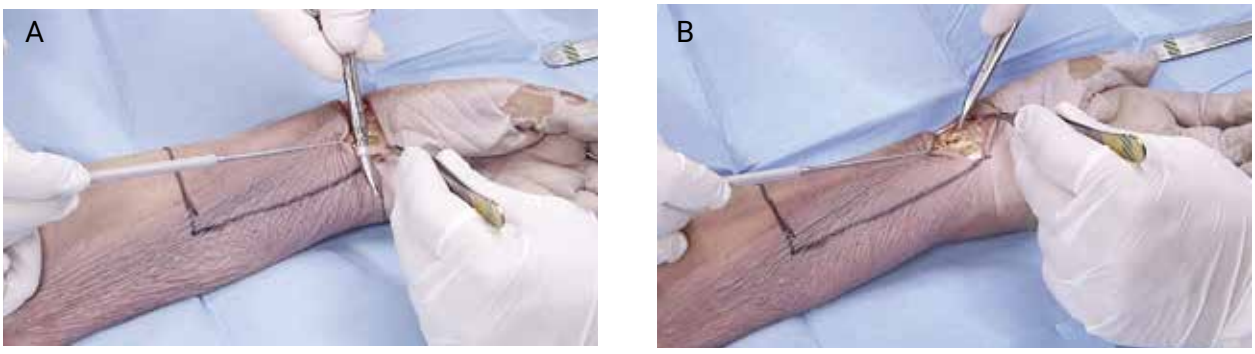

Figure 6.63. Palmaris Longus (A) and Flexor Carpi Radialis (B) are isolated. The artery and its veins are localized between the Brachioradialis and Flexor Carpi Radialis.

Figure 6.64. Proximally, the Cephalic vein has also to be identified and preserved.

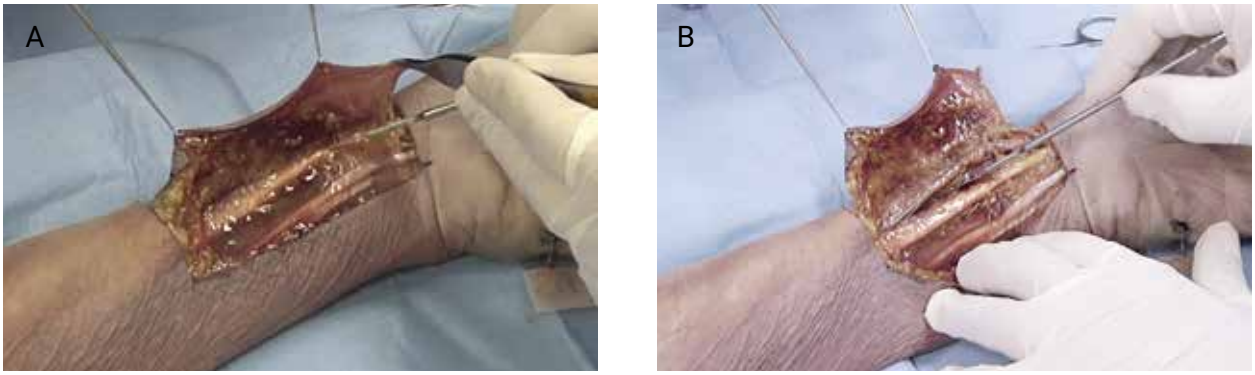

Figure 6.65. A) Subfascial dissection is carried out on the Palmaris longus PL and Flexor carpi radialis (FCR). B) The septum between the FCR and Brachioradialis (BR) is reached and freed. It is deep into this septum that the radial artery is localized and individualized.

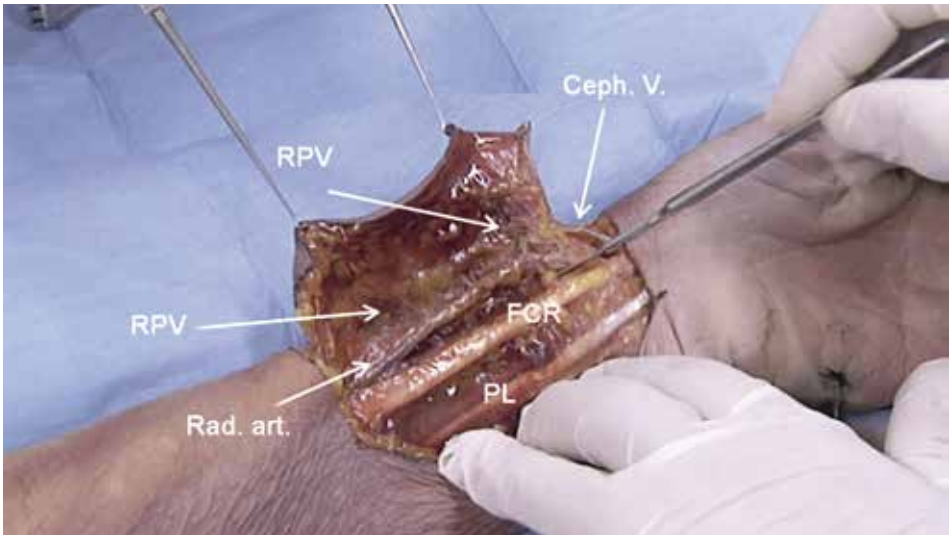

Figure 6.66. Elevation continues by liberating the radial artery from the septum. The cephalic vein and the radial artery with their comitant veins are isolated.

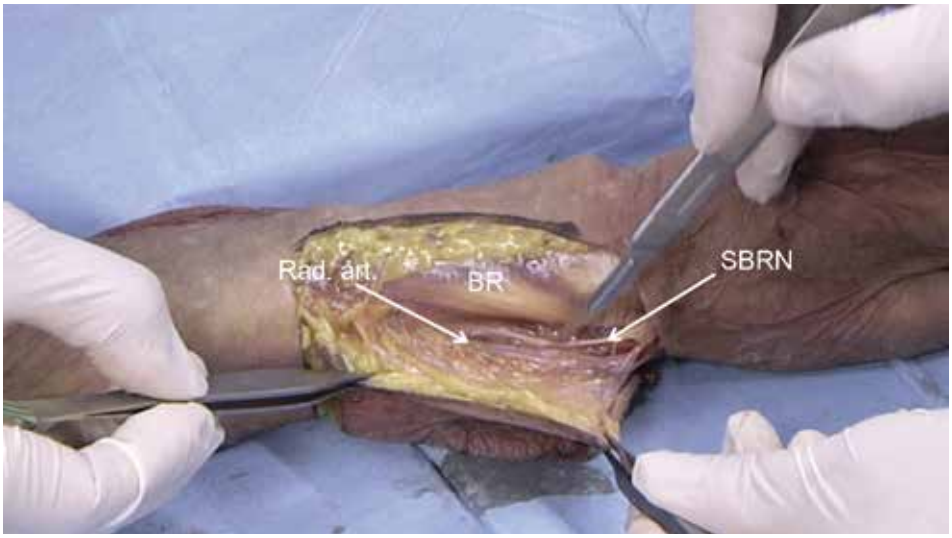

Figure 6.67. Subfascial dissection is performed on the radial side, exposing the septum and the radial artery, as well as the sensory branch of the radial nerve (SBRN). The Radial artery with its venae comitantes and the cephalic vein are all divided and ligated at the wrist level. The sensory branch from the radial nerve is isolated and preserved.

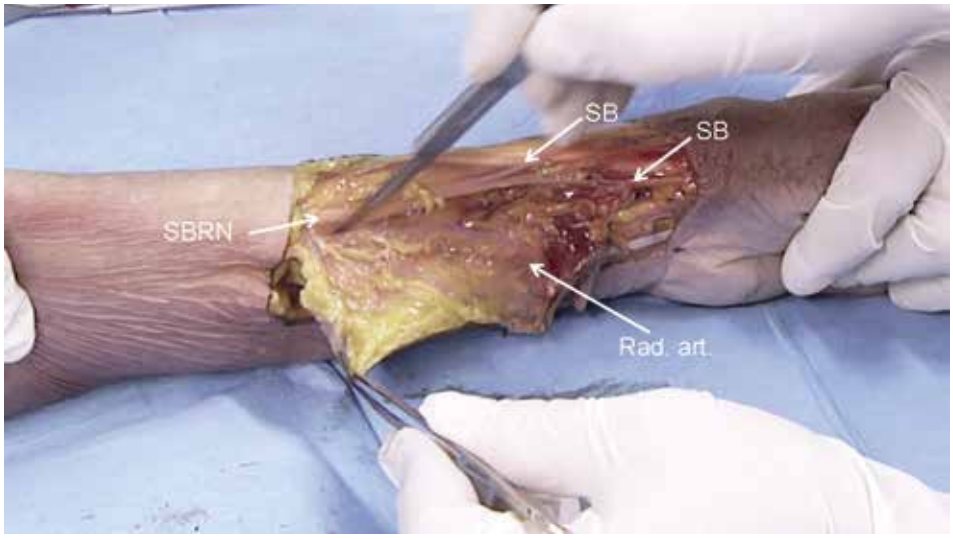

Figure 6.68. The sensory branch (SBRN) not only has to be preserved but also used as a guideline, to dissect the radial aspect of the pedicle from distal to proximal. Minor vascular branches to the muscles are divided and ligated.

Figure 6.69. With the pedicle completely isolated, the inner aspect is freed from the deep intermuscular septum.

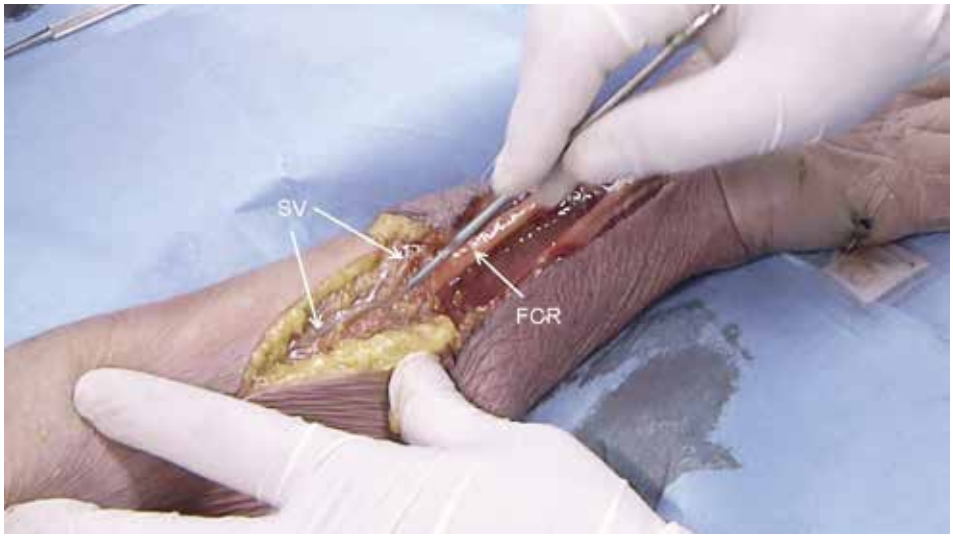

Figure 6.70. If a longer pedicle is required, the skin can be incised proximally. Great care has to be taken not to injure subcutaneous veins (SV) which come up from the flap.

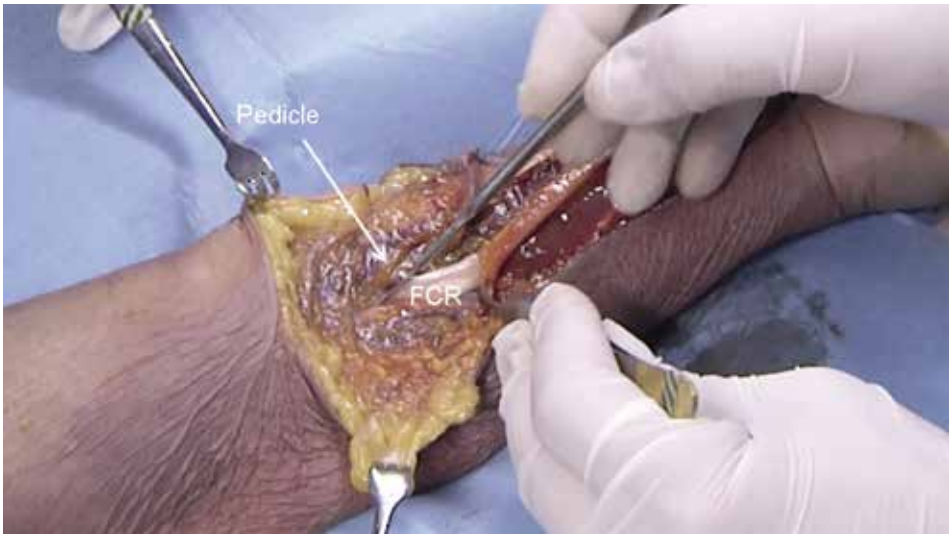

Figure 6.71. Dissection of the pedicle continues upward,always at subfascial plane. The fascia of the Flexor Carpi radialis (FCR) is elevated and included at the pedicle.

Figure 6.72. Subcutaneous dissection continues proximally (taking care not to damage veins coming up from the flap).

Figure 6.73. Medial dissection is performed subfascially leaving the fascia of the Brachioradialis muscle attached to the pedicle and flap.

Figure 6.74. If a longer pedicle is required, the pedicle can be isolated up to the elbow by freeing the septum containing the vessels from the Flexor Carpi Radialis and Brachioradialis muscles.

Figure 6.75. Proximal radial forearm flap already elevated. Though the flap is large and thin, the extensive defect left in the forearm is quite important, and always needs to be skin-grafted.