The profunda brachii then passes into the posterior compartment of the arm with the radial nerve between the lateral and long heads of the triceps, and teres major (triangular interval). It runs with the radial nerve in the spiral groove posterior to the humerus and eventually branches into two terminal divisions – the radial collateral artery and the middle collateral artery (Fig. 12.3). The middle collateral artery enters the medial head of the triceps and ends in the olecranon plexus of the posterior elbow.

The radial collateral artery follows the course of the radial nerve before dividing into anterior and posterior divisions. The anterior division (ARCA) continues to accompany the radial nerve into the flexor compartment between brachialis and brachioradialis to eventually anastomose with the radial recurrent artery (RRA).

However, the posterior division of the radial collateral artery (PRCA) stays in the posterior compartment and eventually reaches the lateral intermuscular septum, where it can be found between the triceps posteriorly and the brachialis anteriorly. It gives rise to several septocutaneous perforators (1–15 cm proximal to the lateral epicondyle) that supply the overlying skin, which corresponds with the vascular territory of the lateral arm flap,[1] before ending in a plexus of vessels around the lateral epicondyle and olecranon. This plexus is also supplied by the ARCA, the interosseous recurrent, inferior ulnar collateral, and the radial recurrent artery (Fig. 12.7). These vessels provide retrograde flow to the PRCA giving the basis for the distally-based lateral arm flap.[2]

The next branch of the brachial artery is the superior ulnar collateral artery. This arises from the brachial artery just distal to the mid-arm in 78% of specimens, or from the profunda brachii in 22%. It pierces the medial intermuscular septum to join the ulnar nerve in the posterior compartment medial to the triceps (Fig. 12.1), and follows the nerve around the medial epicondyle into the forearm (Fig. 12.2). It eventually anastomoses with either the posterior ulnar recurrent artery or a branch of the inferior ulnar collateral artery (Fig. 12.7).

The last branch of the brachial artery in the arm is the inferior ulnar collateral artery. This arises from the medial aspect of the brachial artery 5 cm proximal to the elbow and divides into anterior and posterior branches. The posterior branch runs behind the humerus under the triceps, joining the middle collateral artery to form an anastomotic arch just proximal to the olecranon. The anterior branch passes anterior to the medial epicondyle to anastomose with the anterior ulnar recurrent artery (Fig. 12.7).

ANASTOMOSES AROUND THE ELBOW

Complex anastomoses around the elbow allow for excellent collateral circulation and can be simplified into those that run anterior versus posterior to either the medial or lateral epicondyle (Table 12.1, Fig. 12.7).

Table 12.1 Arterial anastomoses around the elbow

Location	Vessels
Anterior to medial epicondyle	Anterior branch of inferior ulnar collateral Anterior ulnar recurrent Anterior branch of superior ulnar collateral
Anterior to lateral epicondyle	Radial recurrent artery (RRA) Anterior radial collateral branch of profunda (ARCA)
Posterior to medial epicondyle	Middle collateral branch of profunda Inferior ulnar collateral
Posterior to lateral epicondyle	Posterior radial collateral

EXPOSURE OF THE BRACHIAL ARTERY IN THE MEDIAL ARM

The brachial artery can be exposed easily and expeditiously anywhere along its course in the medial arm. With the patient supine, the arm extended on a hand table, and the forearm supinated, a longitudinal incision is marked over the medial biceps groove (Fig. 12.6). Useful surgical landmarks during this dissection include the bicipital groove, the medial epicondyle, the basilic vein and the medial intermuscular septum. The incision can be made anywhere from the elbow crease to the axilla, depending on the surgical requirements (Fig. 12.8A). The skin and subcutaneous fat are incised and attention should be paid to avoiding injury to the basilic vein, which runs in the subcutaneous plane in the distal two-thirds of the arm, and is accompanied by the median antebrachial cutaneous nerve (Fig. 12.8B).

Distally, the brachial artery pulse is easily palpable and the overlying deep fascia is incised to expose the neurovascular bundle. The median nerve lies medial to the brachial artery at this level, and there are also usually two sizeable venae comitantes surrounding the vessel (Fig. 12.8C).

When a proximal approach is necessary, the basilic vein can be a useful landmark as it pierces the deep fascia of the arm to join the neurovascular bundle in the middle to proximal thirds of the arm. The vein can be followed proximally and the sheath incised at this point.

The brachial artery can be used in an end-to-side manner to provide excellent inflow to microvascular reconstructions, or large side branches can be sacrificed for an end-to-end anastomosis.

GROSS REGIONAL ANATOMY OF THE ANTECUBITAL FOSSA

The antecubital fossa is an anatomically complex area, and knowledge of this anatomy allows exposure of multiple structures that may be required for complex upper extremity reconstruction, including exposure of recipient vessels as well as nerves for complex peripheral nerve reconstruction and functional muscle transfer. Important anatomic landmarks include the elbow flexion crease proximally, the brachioradialis laterally, and the pronator teres medially (Fig. 12.9). The floor of the fossa comprises the brachialis muscle for the most part.

The biceps tendon and aponeurosis are centrally located and somewhat divide the fossa into medial and lateral

Figure 12.8 Cross-sectional anatomy of the forearm. (Reprinted from Netter Anatomy Illustration Collection. ©Elsevier Inc. All Rights Reserved.)

compartments. In the superficial plane, the antecubital fossa has a rich subcutaneous veno us network that can be used for recipient venous anastomoses or vein grafts harvest (Fig. 12.10). The lateral antebrachial cutaneous nerve also lies in the subcutaneous plane, on the lateral side of the fossa having exited the deep fascia of the distal arm just lateral to the biceps (Fig. 12.11), and this nerve can be harvested as a nerve graft, although results in a distal sensory deficit (Fig. 12.12)

On the medial side of the fossa, lying deep to the fascia and lacertus fibrosus, are the median nerve and the brachial artery. Lateral to the artery is the biceps tendon that heads deep into the fossa to insert on the radial tuberosity, and this insertion may need to be exposed in functional muscle transfers for elbow flexion. Lateral to the biceps tendon, the radial nerve enters the antecubital region deep to the brachioradialis muscle belly, and divides into its two terminal branches (Fig. 12.4).

EXPOSURE OF THE DISTAL BRACHIAL ARTERY AND ITS BIFURCATION

At the elbow crease, the brachial artery becomes an anterior structure laying on the brachialis muscle in the middle of the antecubital fossa. At this level, it is covered only by the lacertus fibrosus, the median cubital veins and skin. It is located between the muscle bellies of the pronator teres and brachioradialis until it bifurcates approximately 2–3 cm distal to the elbow crease (Fig. 12.7).

With the arm extended and the forearm supinated, a skin incision is made along the medial bicipital groove starting 4–5 cm proximal to the flexion crease of the elbow. At the crease, the incision continues obliquely or transversely, then distally along the medial border of the brachioradialis muscle (Fig. 12.13A). Subcutaneous veins can be ligated and divided, or preserved for use as recipient outflow vessels. Specific attention should be paid to sizeable cutaneous nerve branches that may be encountered during this approach, as injury leads to distal paresthesias and painful neuroma formation. The medial antebrachial cutaneous nerve lies with the basilic vein on the medial aspect of the exposure in the distal arm (Fig. 12.13B), and the lateral antebrachial cutaneous nerve is located on the lateral side of the exposure (Fig. 12.13D).

The lacertus fibrosus can be seen arising from the biceps tendon, fanning out medially over the pronator teres and flexor muscle mass (Fig. 12.13B). It is essentially continuous with the distal aspect of the deep fascia of the arm. To access the distal brachial artery, this deep fascia is incised and reflected, exposing the median nerve, which, by now has become medial to the brachial artery (Fig. 12.13C). Sizeable venae comitantes can be preserved and used for outflow anastomoses.

In order to access and expose the bifurcation of the brachial artery in the antecubital fossa, the fascial opening is continued distally by incising the lacertus longitudinally over the pronator and reflecting it proximally (Fig. 12.13C).

Directly underlying the lacertus is the continuation of the brachial artery, lying between the biceps tendon and the median nerve. The median nerve gives off several nerve branches medially, supplying the muscles of the flexor-pronator mass, then heads deep to pronator teres. The nerve and its branches should all be preserved, and the brachial artery can be bluntly dissected distally as it moves away from the nerve, running towards the biceps tendon to become centrally located in the fossa, between the pronator teres medially and the brachioradialis laterally. The lateral antebrachial cutaneous nerve also lies on the lateral side of the fossa and should be preserved.

The deep fascial incision is extended distally and the pronator teres and brachioradialis muscles are separated and retracted, exposing the bifurcation approximately 2–3 cm distal to the elbow crease (Fig. 12.13E). The larger and more medial of the branches is the ulnar artery and this dives deep, under the flexor-pronator mass before giving off the common interosseous branch on its lateral and deep side (Fig. 12.13F).

The radial artery branch remains at a more superficial level, lying on or lateral to the pronator muscle belly, directly under and medial the brachioradialis. It gives off multiple branches on the radial side, the first and largest of which is