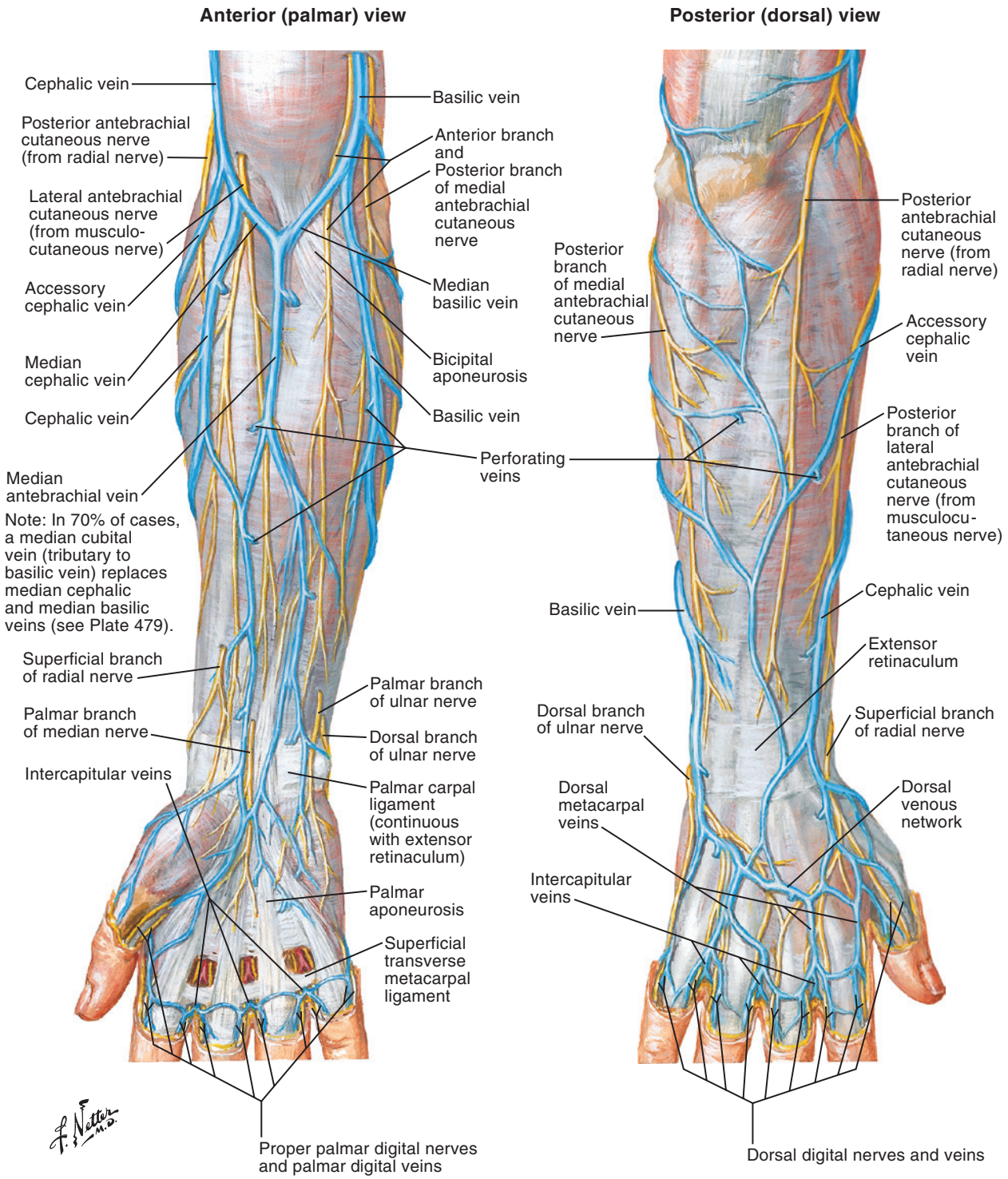

Figure 12.22 Superficial veins and cutaneous nerves of the forearm. (Reprinted from Netter Anatomy Illustration Collection. ©Elsevier Inc. All Rights Reserved.)

(extensor digitorum and indicis tendons) contains the posterior interosseous nerve, which can be harvested for use as a graft in digital nerve reconstruction.

Directly underlying the extensor tendons are the carpal bones and the metacarpals. The dorsal interossei lie between the metacarpals covered by a layer of deep fascia. The dorsal metacarpal arteries can be located on or under this fascia, although are occasionally found intramuscularly (Fig. 12.20).

VASCULAR ANATOMY OF THE HAND

The gross vascular anatomy of the hand is well-defined, however there are several arterial branching patterns that can be clinically relevant, most importantly completeness of the superficial and palmar arches.[12] Conventional angiography (rather than CT angiography) is the gold standard for defining these patterns clinically if the specific arterial anatomy is deemed crucial to the operation.

The arterial supply to the hand is usually derived from the ulnar and radial arteries alone, although a persistent median artery can contribute to the superficial arch in up to 10% of specimens. In general, the ulnar artery is the dominant artery and supplies the superficial palmar arch, giving rise to the common and proper digital arteries, while the radial artery is typically nondominant and supplies the deep palmar arch, the princeps pollicis, and the radial digital artery to the index finger.

When the ulnar artery fails to reach the thumb and index finger, an arch is considered incomplete.

In a large series of cadaveric dissections, the deep palmar system has been found to be a complete arch (i.e., the radial artery anastomoses with the deep branch of the ulnar artery) in approximately 97% of specimens, but can be incomplete in 3%.[12]

The superficial palmar system is a complete arch (ulnar artery supplies all digits and the thumb) in approximately 80% of specimens, and in the remaining 20% an incomplete superficial arch can exhibit a number of variable branching patterns in the palm. Identification of an incomplete superficial system is important when considering reverse flow pedicled flaps for coverage of hand defects, most commonly the distally-based radial forearm flap, as sacrificing the radial artery would likely result in an ischemic hand. Completeness of the superficial arch can be confirmed preoperatively by an Allen's test or arteriography. Intraoperatively, this can be confirmed by occluding flow in the radial or ulnar artery using microvascular clamps, then examining distal perfusion.

A dorsal carpal arch is also present, fed by branches of the radial, ulnar and posterior interosseous arteries. This arch supplies the carpal bones and dorsal metacarpal arteries and can be used to design pedicled bone or fasciocutaneous flaps from the dorsum of the hand and wrist.

THE SUPERFICIAL PALMAR ARCH AND THE DIGITAL ARTERIES

The superficial palmar arch is formed from the continuation of the ulnar artery, with contributions from the superficial palmar branch of the radial artery, although there are several variations. The ulnar artery passes through Guyon's canal initially deep to the ulnar nerve and palmaris brevis. It runs distally superficial to the flexor digiti minimi but remains deep to the palmar fascia, curving radially to form the arch proximal to the mid-palmar crease. As it continues radially, it remains superficial to all the flexor tendons and the branches of the median and ulnar nerves. The superficial arch gives rise to the proper digital artery to the ulnar side of the small finger, and three common digital arteries (to the 4th, 3rd, and 2nd web space) (Fig. 12.15). Each of these vessels receives a contribution from a corresponding palmar metacarpal artery that arises from the deep palmar arch. Proximal to the metacarpal neck, each common digital artery is superficial to each of the associated common digital nerves, however distal to this level, the proper digital artery becomes deep to its corresponding nerve and this relationship is maintained throughout the digit where they are bound by Cleland's ligament dorsally, and Grayson's ligament on the volar side.

The proper digital arteries communicate across each finger via arcades usually located at the level of each joint. This allows for distally based homodigital island flaps to be designed based on retrograde flow.

The digital arteries to the thumb and radial side of the index finger typically arise from the radial artery or the first part of the deep palmar arch.

THE DEEP PALMAR ARCH AND PRINCEPS POLLICIS

The deep palmar arch is the continuation of the radial artery, traversing the palm at the level of the metacarpal bases, and is proximal to the superficial arch in the majority of cases (Fig. 12.21). It is located in a plane deep to the flexor tendons, lumbricals and adductor pollicis, but superficial to the interossei. It gives off 3–4 palmar metacarpal arteries that eventually join the common digital arteries of the superficial arch just proximal to the web spaces, and several perforating branches that dive deep between the second, third and fourth intermetacarpal spaces and anastomose with the dorsal metacarpal arteries on the dorsum of the hand. The distal perforating branches are located at the level of the metacarpal neck and provide the inflow and pivot point for distally based dorsal metacarpal artery island flaps.

Just prior to forming the deep palmar arch, the radial artery gives rise to the princeps pollicis and radialis indicis arteries.

The princeps pollicis artery arises immediately after the radial artery enters the deep palm by passing from its terminal location dorsal to the thumb base, through the two heads of the first dorsal interosseous (Fig. 12.16). It continues along the ulnar aspect of the thumb metacarpal, deep to the first dorsal interosseous, adductor pollicis and flexor pollicis longus tendons, and divides at the level of the metacarpal neck into radial and ulnar proper digital arteries that continue to the thumb tip. The radialis indicis (radial digital artery to the index finger) arises just distal to the princeps pollicis. Occasional these two vessels arise from a common trunk rather than directly from the radial artery.

VENOUS ANATOMY OF THE ARM, FOREARM, AND HAND

The veins of the upper extremity are divided into superficial and deep groups. There is significant variability in the anatomy of both groups, however the superficial veins are found in the subcutaneous tissues, with the deep veins being located deep to the deep fascia, typically accompanying named arteries (Figs 12.10, 12.21, 12.23). The brachial, radial, and ulnar arteries all have sizeable concomitant veins that can be used as recipient veins in microsurgical cases. The superficial and deep systems have multiple connections throughout the upper extremity, and there is usually an abundance of veins available at all levels for use as recipient vessels or vein graft. The basilic vein is superficial (Fig. 12.21).

The majority of the venous drainage of the hand is directed from the small, fragile superficial palmar veins and deep veins into the superficial venous network on the dorsum of the hand. The dorsal digital veins coalesce to form multiple large veins over the metacarpals. The radial side of this plexus eventually forms the cephalic vein, while