

**Fig. 18-68.** Paramedian section of the dorsal part of the hoof of a horse, showing horn tubules and the horseshoe with a hoof nail (plastic); courtesy of H. Obermaier, Munich.

### Periopic segment (limbus)

The periopic segment forms a band a few millimetres thick just distal to the hairy skin and extends onto the heel bulbs palmarly/plantarly.

The **subcutis of the periople** (tela subcutanea limbi) is modified to form the bulging periopic cushion, which joins the heel bulbs on the back.

The **dermis of the periopic segment** (dermis limbi) is studded with slender papillae (papillae dermales) a few millimetre long (Fig. 18-67).

The **epidermis of the periopic segment** comprise the external layer (stratum externum) of the wall. It forms a band of soft, rubbery horn a few millimetres thick near the coronet, but dries to a glossy thin layer distally (Fig. 18-68). The periople consists of an admixture of tubular and intertubular horn, which loses its tubular structure more distally. The periopic horn is usually worn off when it reaches the middle of the hoof wall.

The **horn cells** and the **membrane binding material** are able to bind water, so that the periopic horn acts as a fluid reservoir to keep the underlying coronary horn moist and thus elastic. The lipid component of the membrane binding material prevents the horn from both soaking up and losing too much water.

### Coronary segment (corona)

The coronary segment constitutes a band up to 15 mm in width distal to the periopic segment (Fig. 18-67). The underlying **subcutis** (tela subcutanea coronae) is thickened to form the **coronary cushion** (pulvinus coronae) that bulges outward at the coronet.

The **coronary dermis** (dermis coronae) forms numerous papillae up to 8 mm in length and arranged in rows and directed distally.

The **coronary epidermis** (epidermis coronae) produces horn of a distinct **tubular structure** (Fig. 18-68). It reaches a thickness of 1.2 cm and runs distally toward the weight-bearing margin parallel to the parietal surface of the distal phalanx. It is very resistant to stress and strain and forms the **middle layer** (stratum medium) of the hoof wall. The coronary horn can be further subdivided into **outer, middle and inner layers** characterised by different types of horn tubules (Fig. 18-67). The outer layer is predominantly composed of horn tubules oval in cross section. In the outer and middle layer the horn cells forming the tubules are arranged in several layers, similar to the architecture of an onion. This form of construction provides the maximum resistance against radiate forces directed from the outside to the inside. The **inner layer** of the coronary horn consists of round horn tubules,

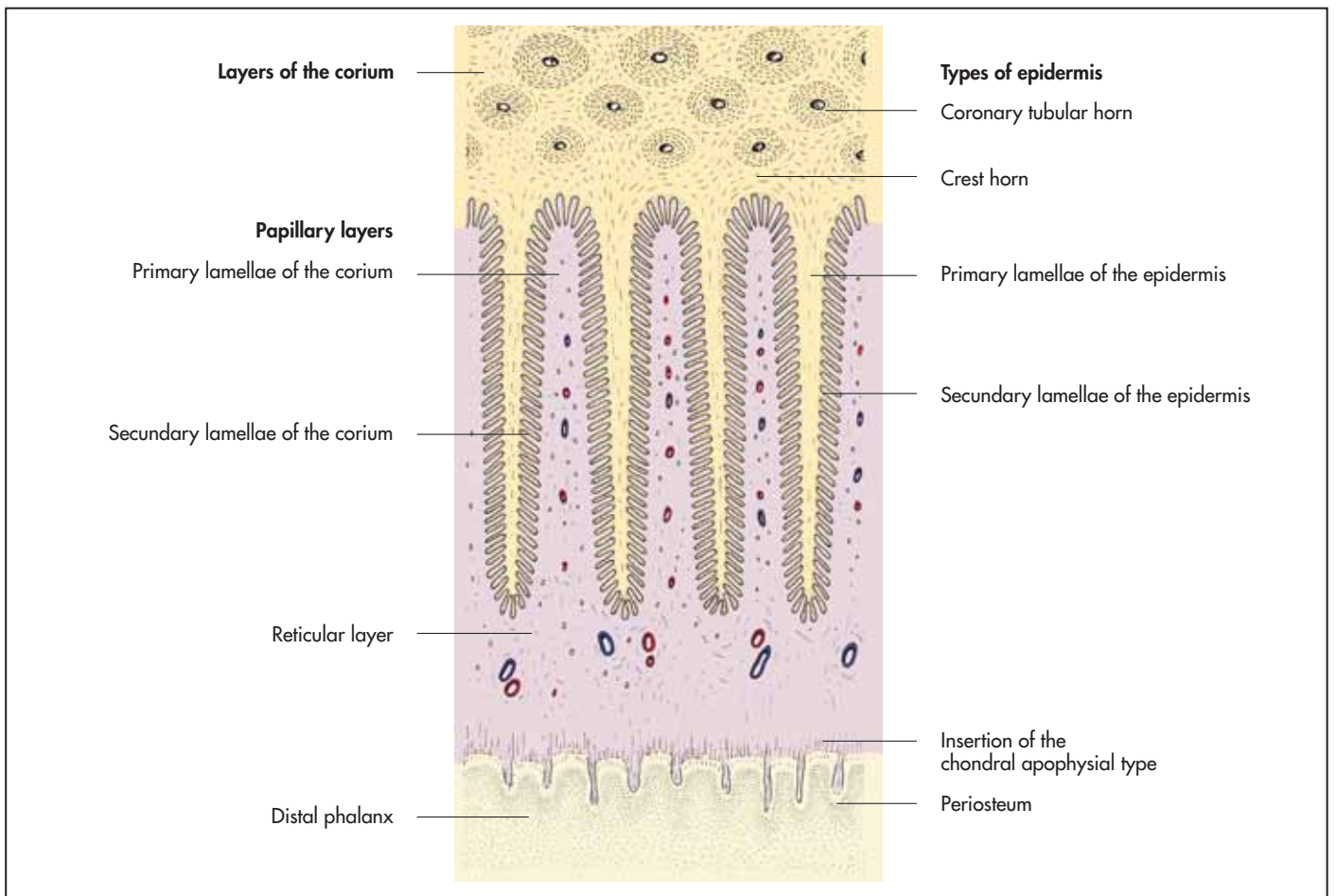


Fig. 18-69. Suspension of the distal phalanx, horizontal section (schematic).

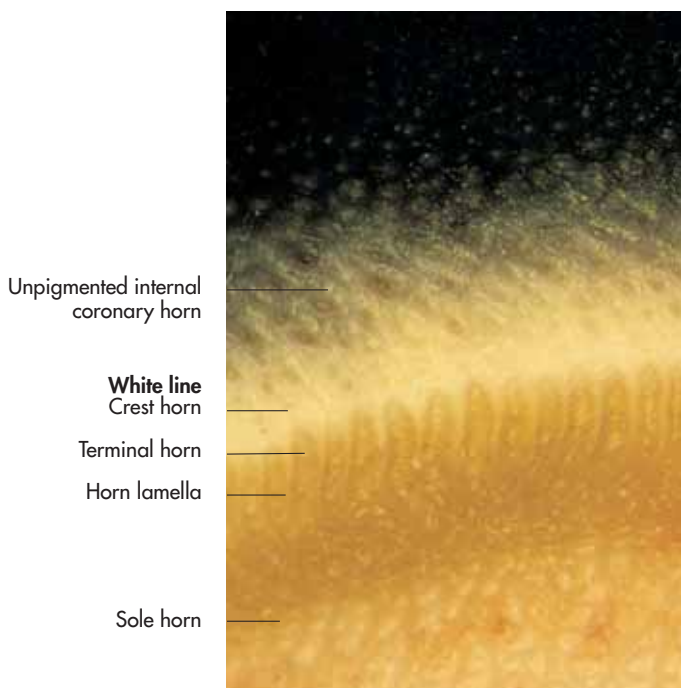


Fig. 18-70. White line of an equine hoof.

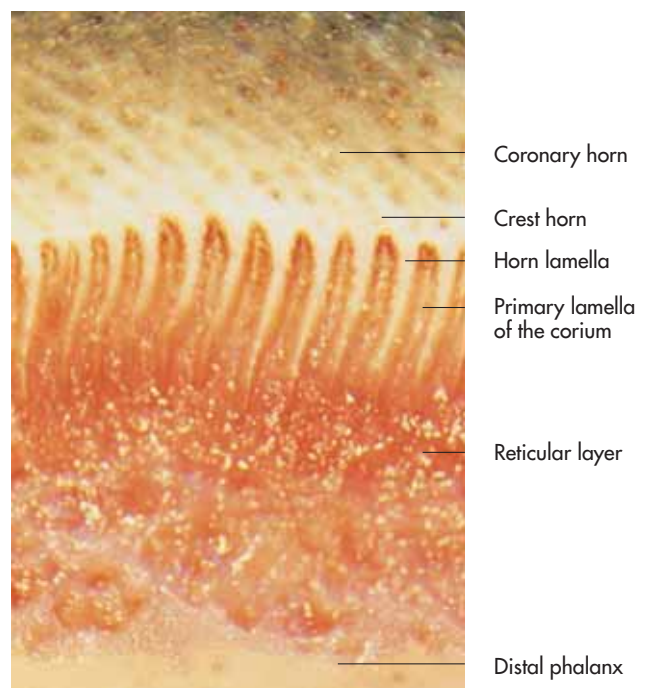


Fig. 18-71. Suspension of the distal phalanx of an equine hoof (horizontal section).

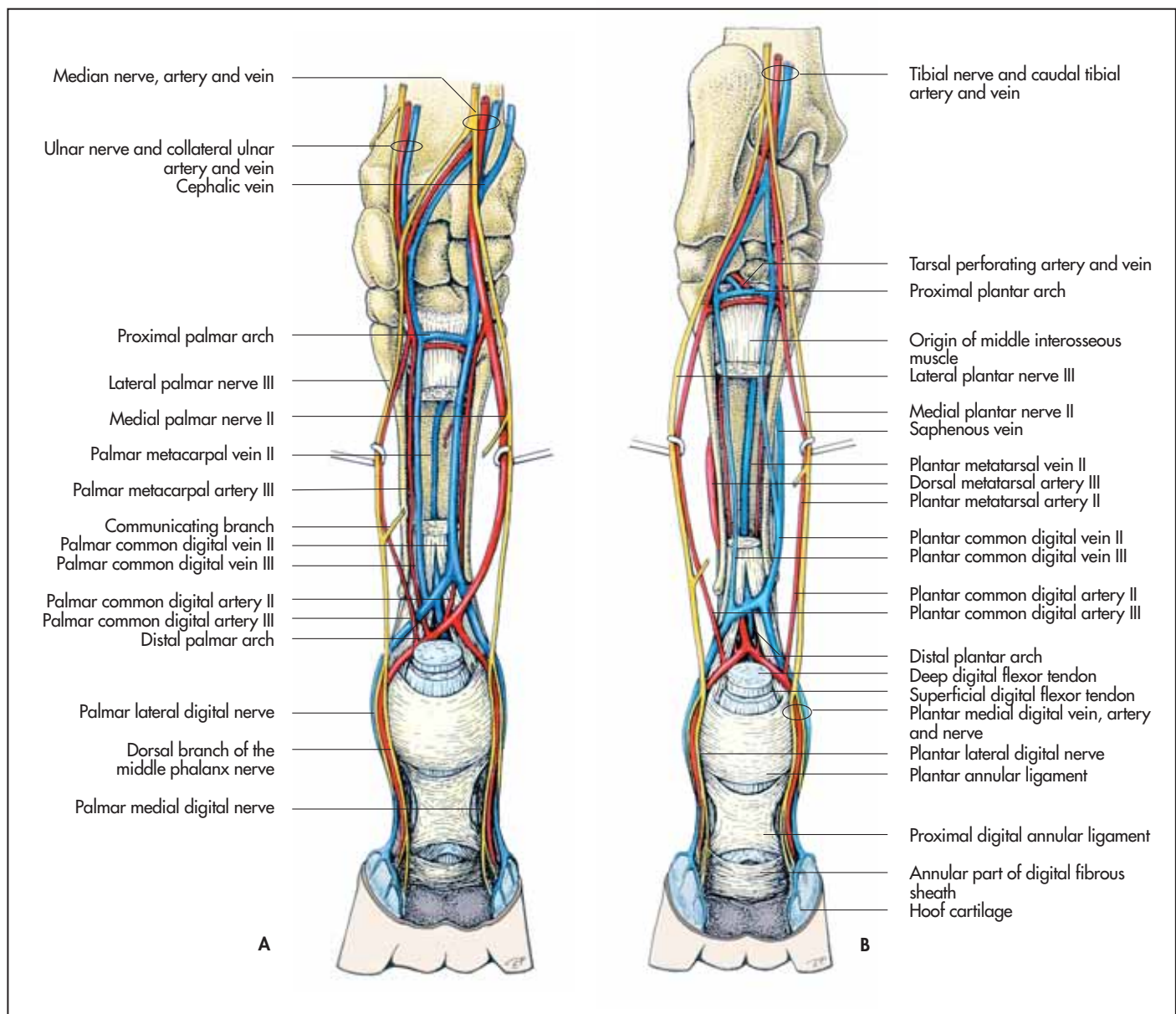


Fig. 18-72. Blood vessels and nerves of the autopodium of the fore- and hindlimbs of the horse (A palmar aspect, B plantar aspect).

which contain spindle-shaped horn cells in its cortex. This arrangement provides resistance against proximodistal forces, thus acting as shock absorbers. The boundary between the inner and middle layer, where the two different horn types come together, is predisposed for fissures which can lead to cracks in the hoof wall.

### Wall segment (paries)

The wall segment forms the **internal segment** (segmentum internum), which lies beneath the coronary horn (Fig. 18-67). It becomes visible only on the surface of the sole as the **white line** (zona alba), the junction between the sole and the wall.

There is **no subcutis** underlying the wall segment. The reticular layer of the wall dermis (**dermis parietis**) is directly adjacent to the parietal surface of the distal phalanx.

The dermis of the wall segment consists of about 600 **primary laminae** (lamellae dermales) that run in a proximodistal direction and are on average 3.5 mm long in the warmblood horse. The primary laminae bear about 110 secondary laminae each, which are also orientated proximodistally (Fig. 18-69). They also carry some papillae on the crest at their proximal origin and at their distal ending. The distal crest papillae are continuous with the finger-shaped terminal papillae, which form the end of each lamina (Fig. 18-67).

Corresponding to the structure of the dermis, the epidermis of the wall segment also forms primary and **secondary lamellae** (lamellae epidermales) that interdigitate with the dermal laminae. Only the primary laminae possess a horny layer. They slide gradually toward the ground, pushed by continuous proliferation, and appear on the ground surface as the white line. The epidermis over the crest papillae forms horn tubules, which



Fig. 18-73. Arteriogram of the foot of a horse, dorsopalmar (left) and lateromedial (right) projection.

usually have lost their tubular structure before they reach the ground surface (Fig. 18-69). The cornification process for the **lamellar horn** is of the **hard type**, while cornification over the **papillae** is of the **soft type**. The terminal horn formed by the epidermis over the terminal papillae at the distal end of the laminae consists of horn tubules with a wider diameter and large medullary spaces. In the white line, it becomes visible as yellowish-brown horn, filling the gaps between the lamellar horn.

The horn of the wall constitutes the junction between the coronary horn and the wall segment, which is firmly attached to the underlying bone. The long horn cells of the epidermal laminae are characterised by multiple fluid-filled chambers, which provide the elasticity of a multichambered waterbed.

The **white line** (zona alba) forms a flexible junction between the hard coronary and the softer sole horn (Fig. 18-70). Its width corresponds to the length of the epidermal laminae. The heterogeneous composition of the white line, where hard laminar horn is mixed with soft tubular horn, causes the white line to be a **point of weakness** with regard to mechanical, chemical and biological damage. The **medulla of the horn tubules** undergoes early destruction and allows fluids and thus infectious agents to become established, resulting in an ascending infection.

In its function as a barrier against environmental influences the horn of the hoof is more effective in the non-domesticated Przewalsky horse than in the modern breeds of horses.

### Sole segment (solea)

The sole segment fills the space between the wall and the frog and forms most of the **undersurface of the hoof**. It is slightly concave, so that only the sole margin and the frog have firm contact to the ground. There is **no subcutis** underlying the sole segment. The dermis of the **sole segment** (dermis soleae) is in direct contact with the sole surface of the coffin bone. Its surface is studded with long papillae, which have a slightly apical orientation (Fig. 18-67).

The **sole epidermis** (epidermis soleae) has a tubular structure (Fig. 18-68). The horny layer, the sole horn, is on average 1 cm thick with considerable regional and individual variations. It is thickest towards the white line, thus providing some support to the latter. The **deeper layers** of the sole horn consist of a combination of tubules and intertubular horn which form a firm unit similar to, but softer than the coronary horn. The **superficial layers** are of a crumbly consistency and which grey in colour; they flake easily, this maintaining the natural concavity of the sole.