Ultrastructure of the Endoneurium

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The endoneurium is a fine cylindrical lamina that encloses groups of axons with their respective Schwann cells, creating a specific microenvironment around them. Collagen fibers, which are the main constituent of endoneurium, surround both myelinated and unmyelinated axons. Being permeable, the endoneurium does not interfere with the passage of molecules.

Collagen fibers present in the endoneurium are mainly type I, and their characteristic features compare with collagen fibers in the layers of the perineurium, as well as with collagen fibers intermingled with the adipocytes that give shape to interfascicular tissue. Collagen is synthesized by Schwann cells and, to a lesser extent, by fibroblasts. This type of fiber confers strength to units formed by axons and their respective Schwann cells.

Despite their scarcity, fibroblasts may be identified readily inside the endoneurium because of their elongated shape and sharp contours. In nerve fibers, fibroblasts tend to be located in the remaining spaces between axons. Fibroblasts have important distinguishing features, including the absence of a basal membrane and large amounts of ribosomes and rough endoplasmic reticulum inside their cytoplasm.

The characteristic tubular shape of the endoneurium is specifically apparent in images obtained under scanning electron microscopy, in which the multichanneled structure formed by the endoneurium to enclose the axons individually is significantly better appreciated.

Continuous capillaries are found inside the endoneurial compartment. These types of capillaries contribute to the blood–nerve barrier. The inner lining of all blood vessels is formed by a single layer of endothelial cells (Figs. 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, 3.11, 3.12, 3.13, 3.14, 3.15, 3.16, 3.17, 3.18, 3.19, 3.20, 3.21, 3.22, and 3.23) [1–7].

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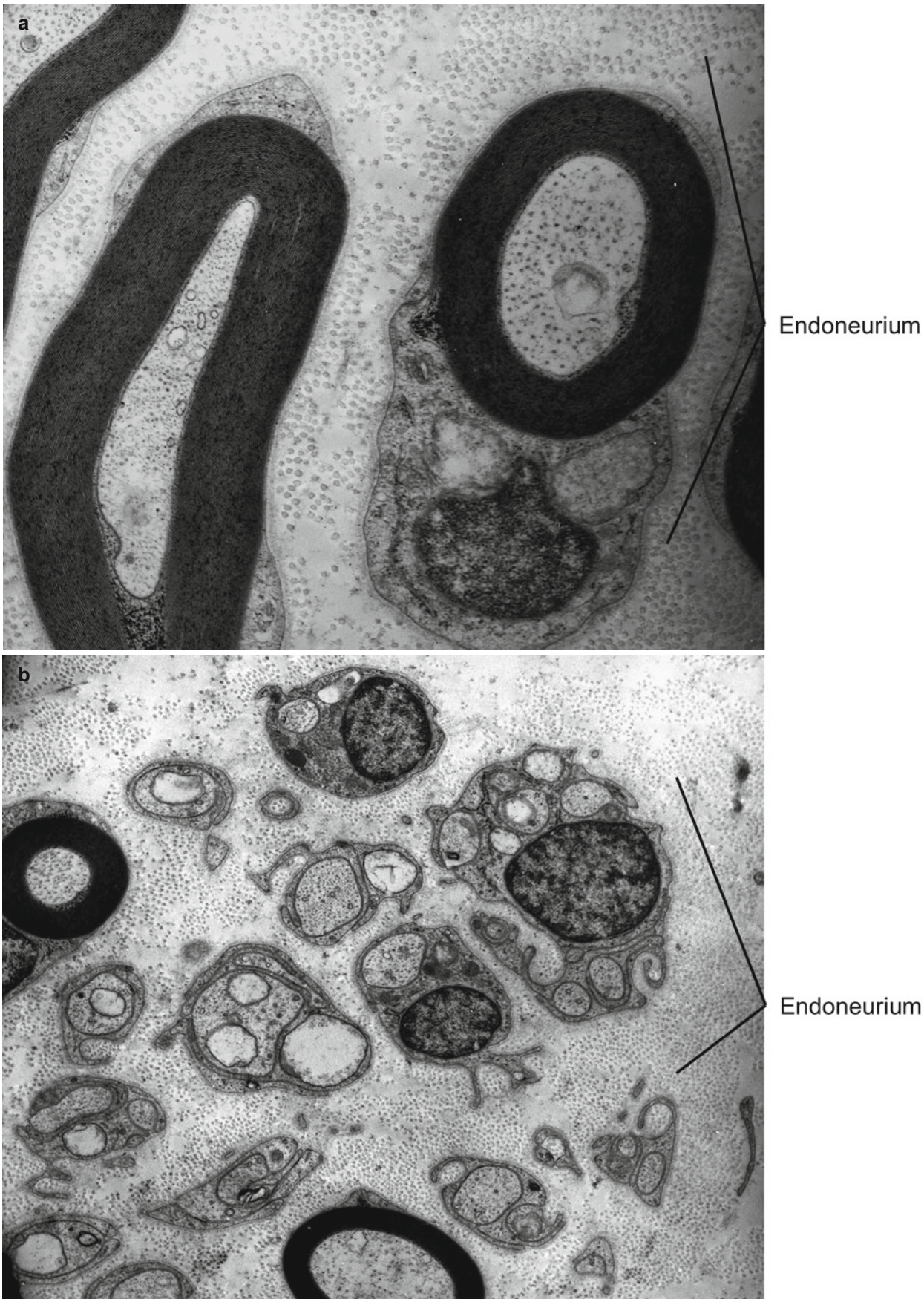

Fig. 3.1 Endoneurium. (**a**, **b**) Myelinated axons enveloped by collagen fibers in a human sciatic nerve. Transmission electron microscopy, magnification: ×12,000 (**a**); ×7,000 (**b**)

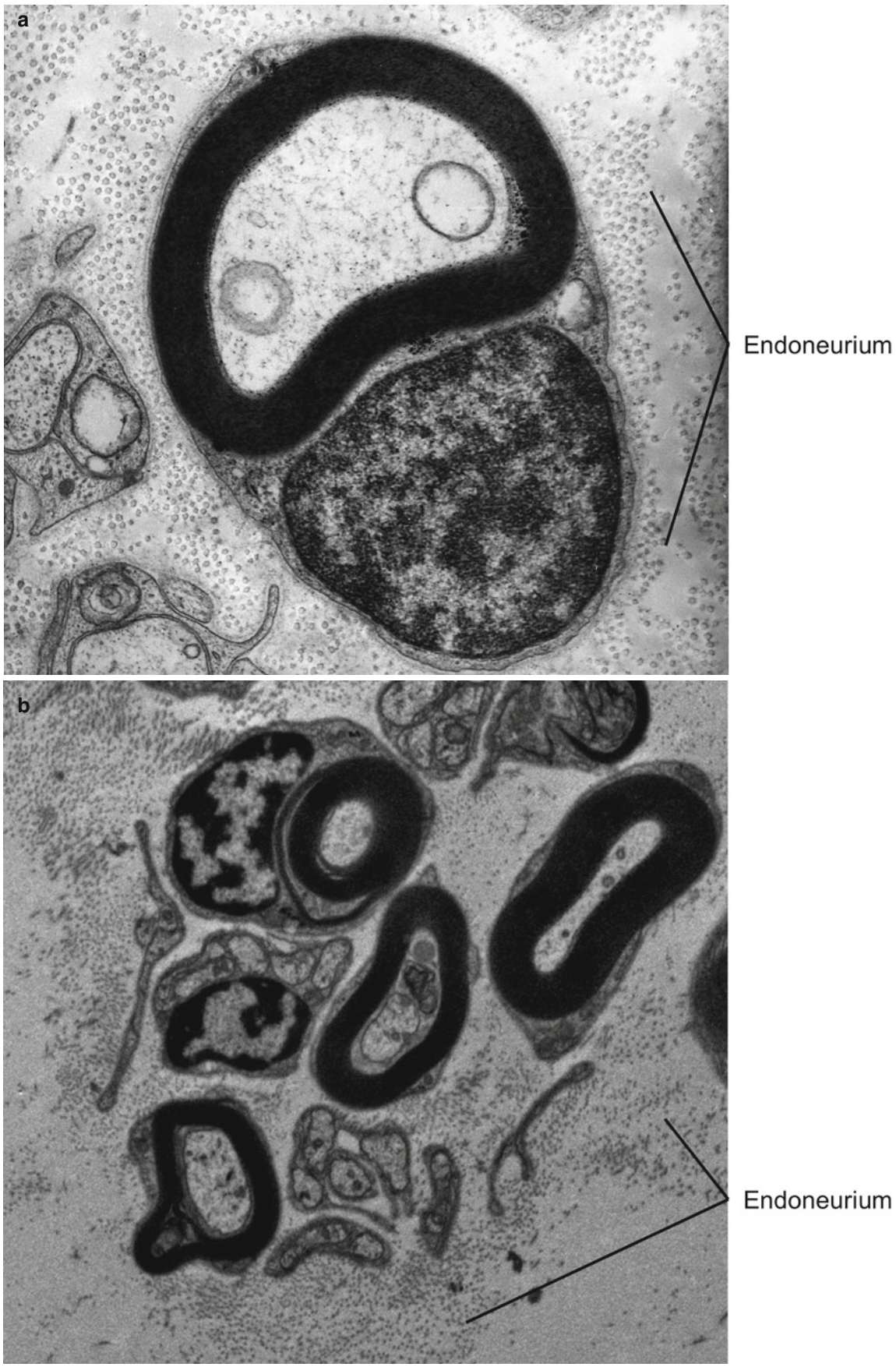

Fig. 3.2 Endoneurium. (**a**, **b**) Myelinated and unmyelinated axons enveloped by endoneurium. This sample was obtained from a human sciatic nerve. Transmission electron microscopy, magnification: ×12,000 (**a**); ×8,000 (**b**)

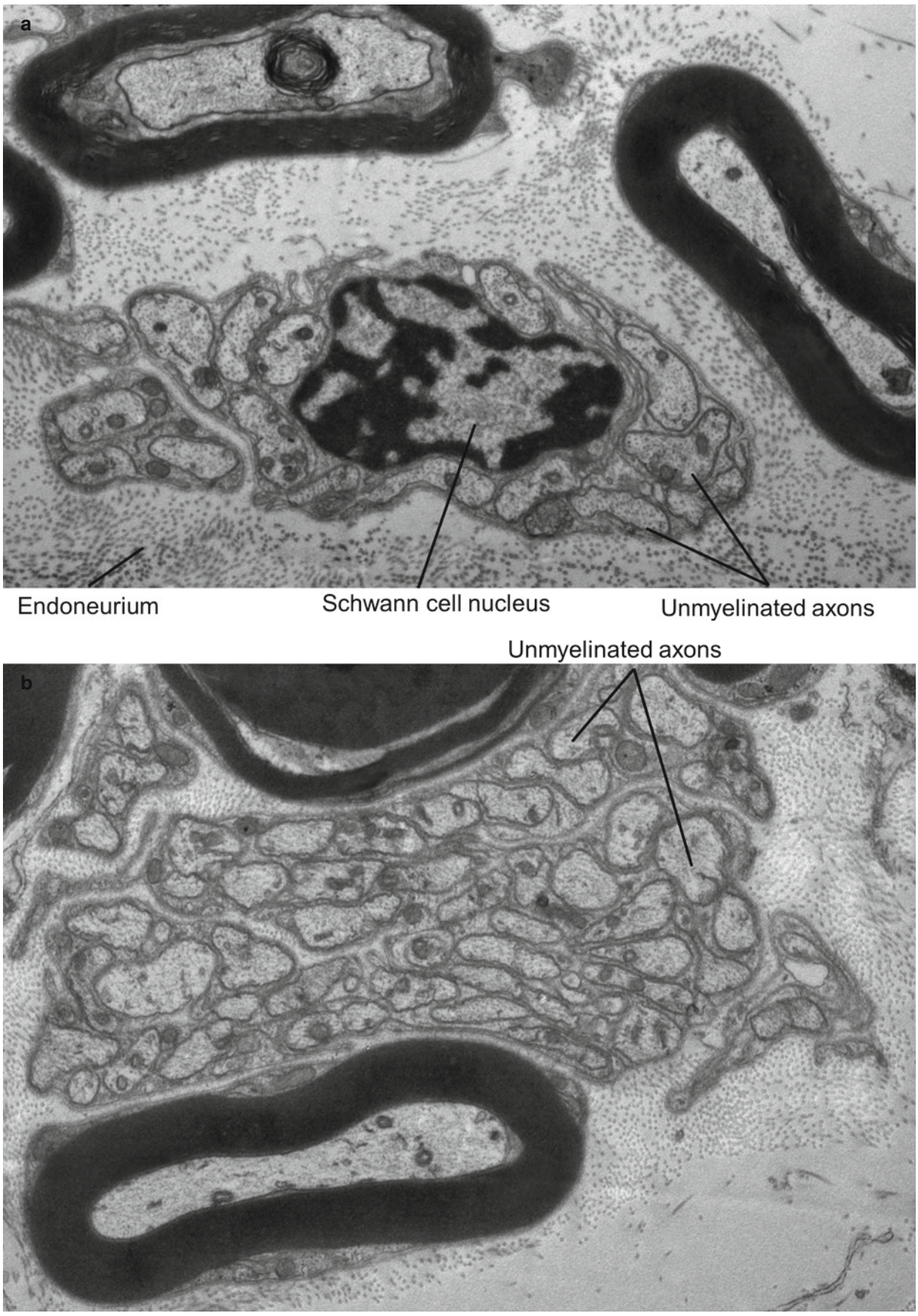

Fig. 3.3 Endoneurium. (**a**, **b**) Myelinated and unmyelinated axons enveloped by endoneurium. The sample was obtained from a human sciatic nerve. Transmission electron microscopy, magnification: ×15,000 (**a**, **b**)

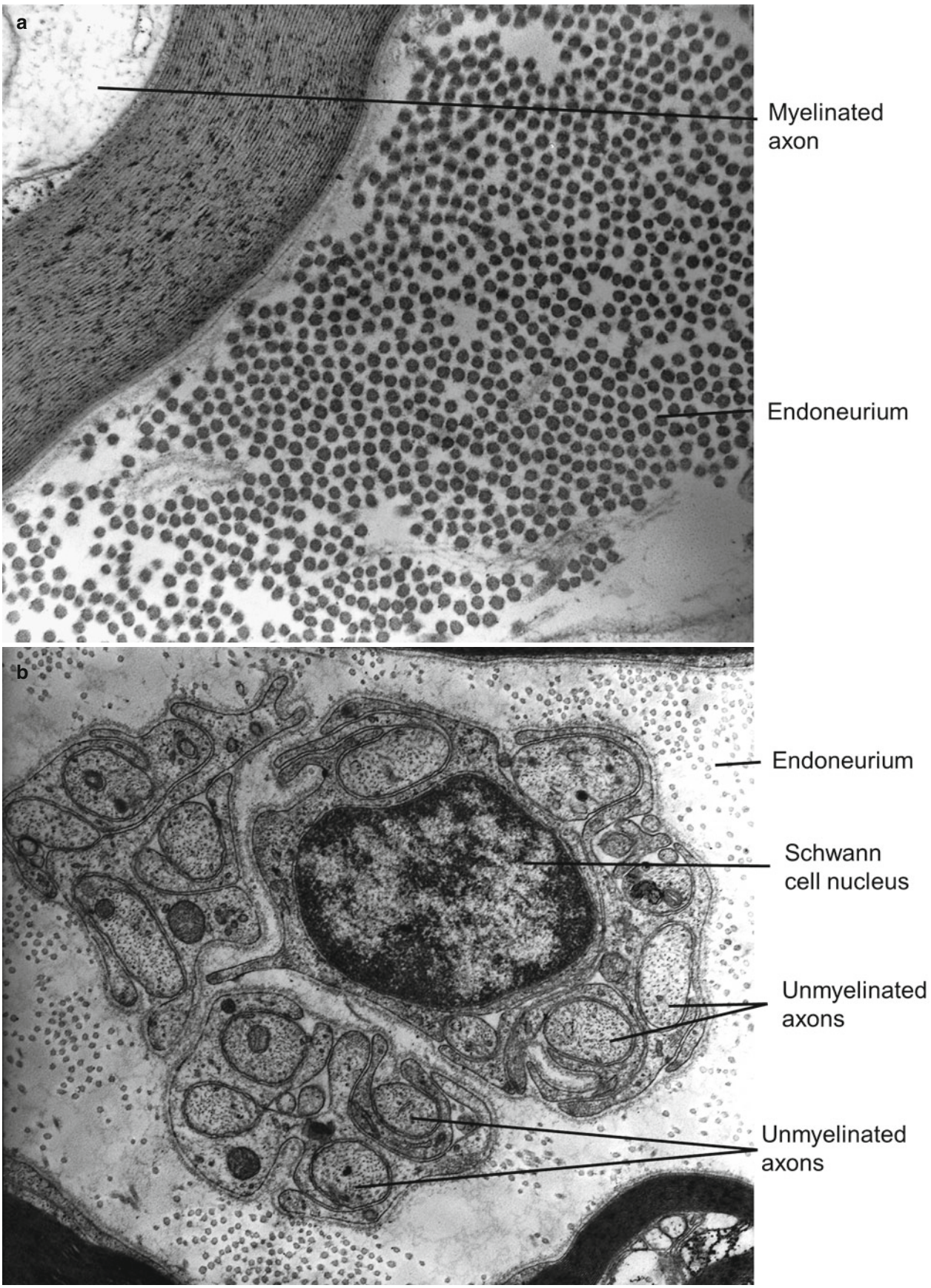

Fig. 3.4 Endoneurium. (**a**) Myelinated axon enveloped by endoneurium. (**b**) Unmyelinated axons enveloped by endoneurium. The sample was obtained from a human sciatic nerve. Transmission electron microscopy, magnification: ×30,000 (**a**); 25,000 (**b**)

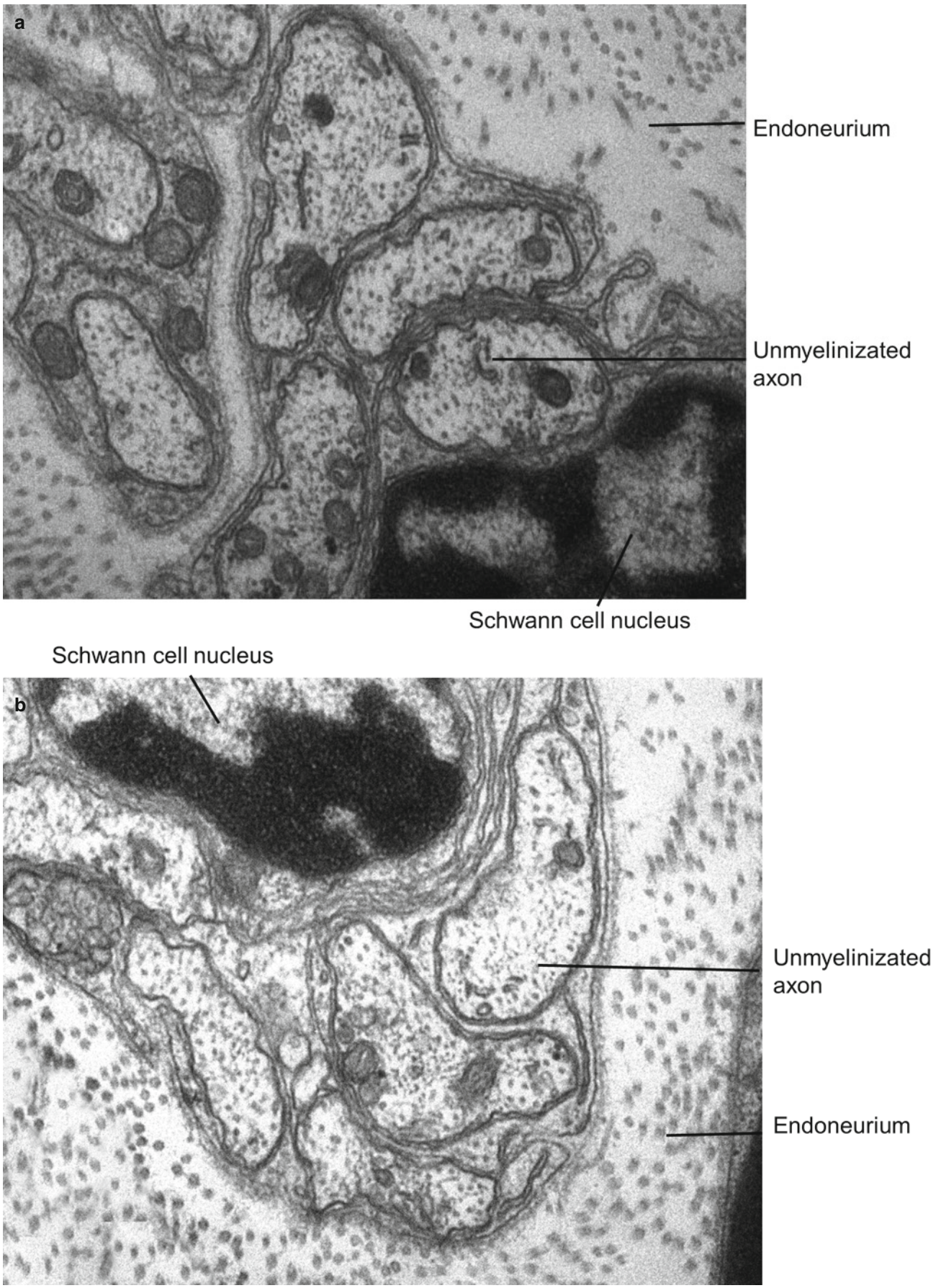

Fig. 3.5 Endoneurium. (**a**, **b**) Unmyelinated axons enveloped by endoneurium. The sample was obtained from a human sciatic nerve. Transmission electron microscopy, magnification: ×50,000 (**a**, **b**)

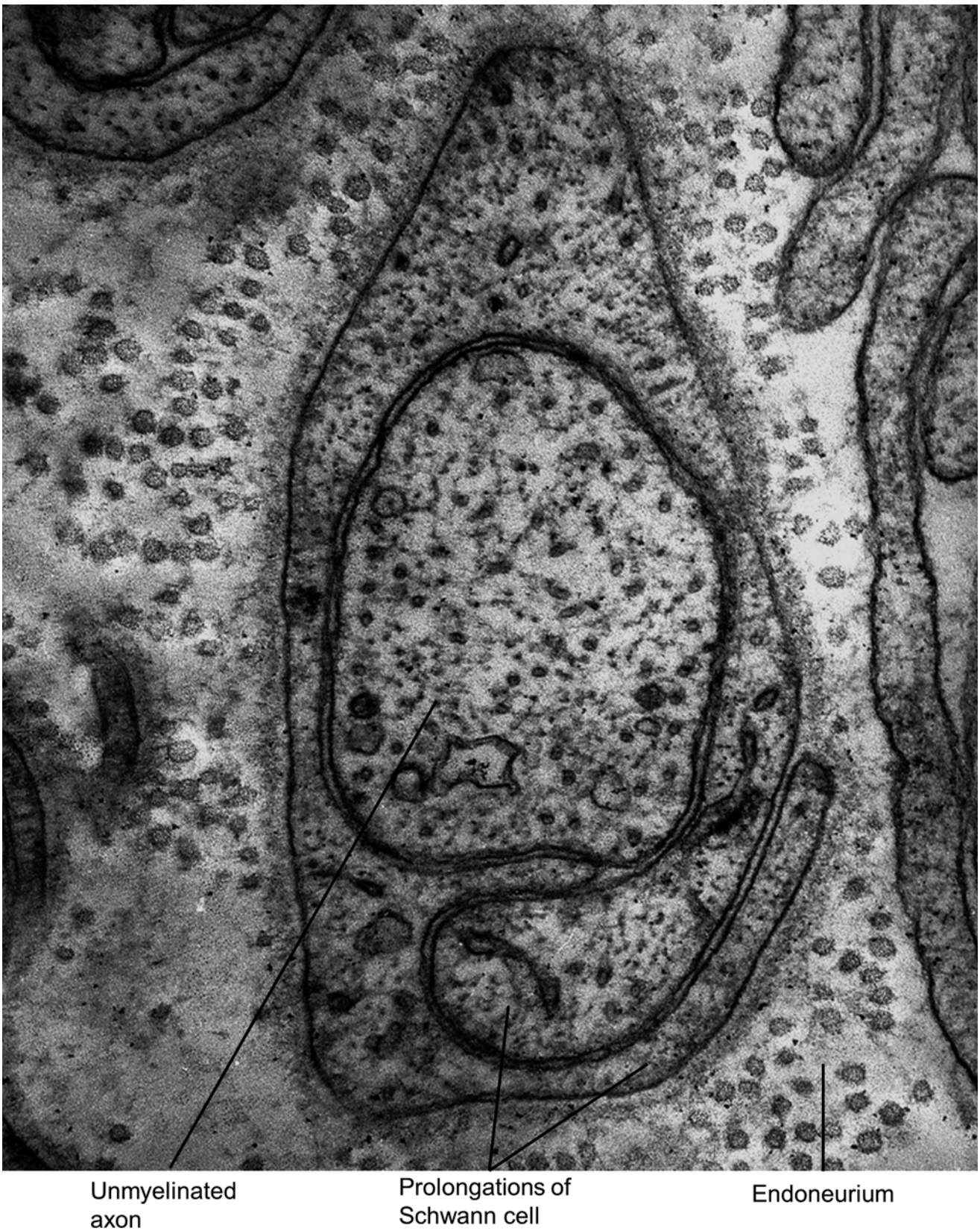

Fig. 3.6 Endoneurium. Unmyelinated axons enveloped by endoneurium. The sample was obtained from a human sciatic nerve. Transmission electron microscopy, magnification: ×150,000

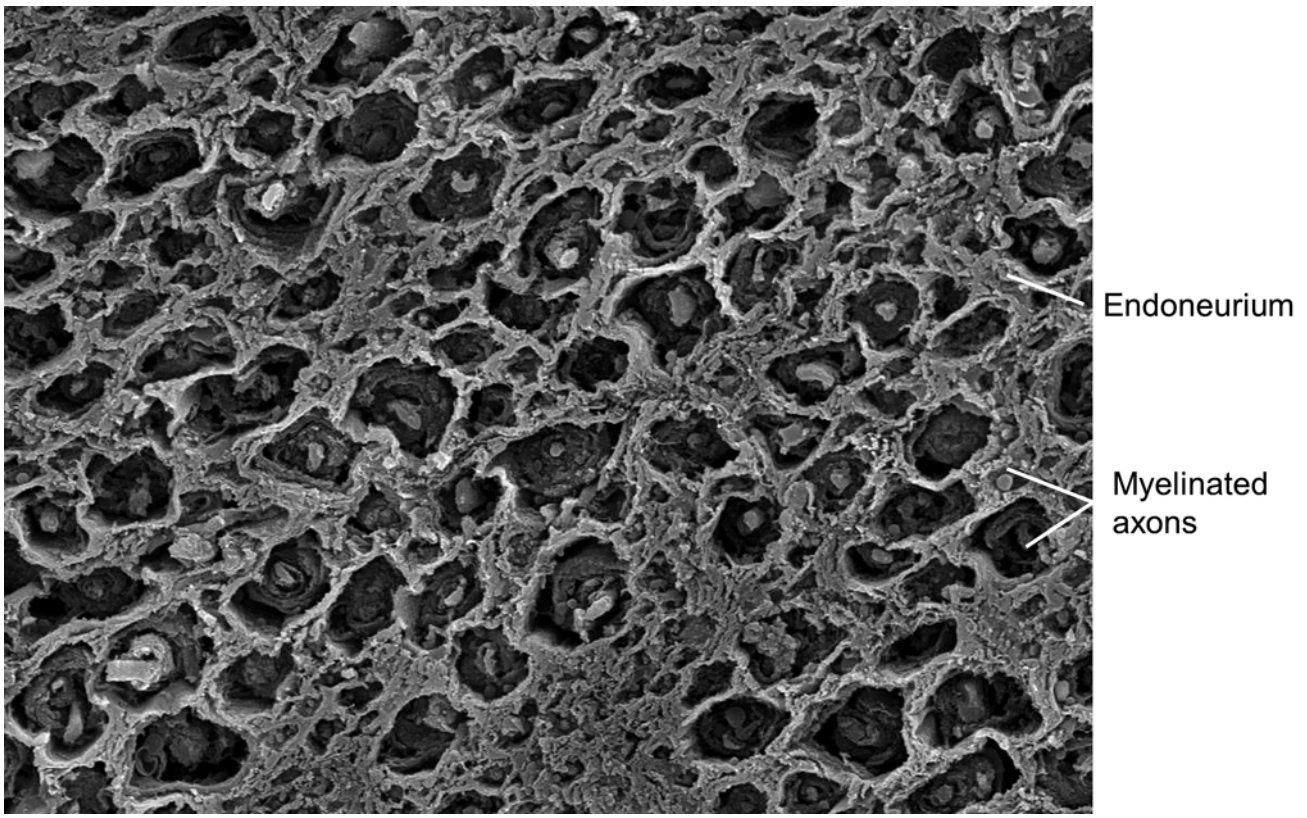

Fig. 3.7 Endoneurium. Myelinated axons enveloped by endoneurium. The sample was obtained from a human sciatic nerve. This technique cannot be used to identify unmyelinated axons. Scanning electron microscopy, magnification: ×1,000

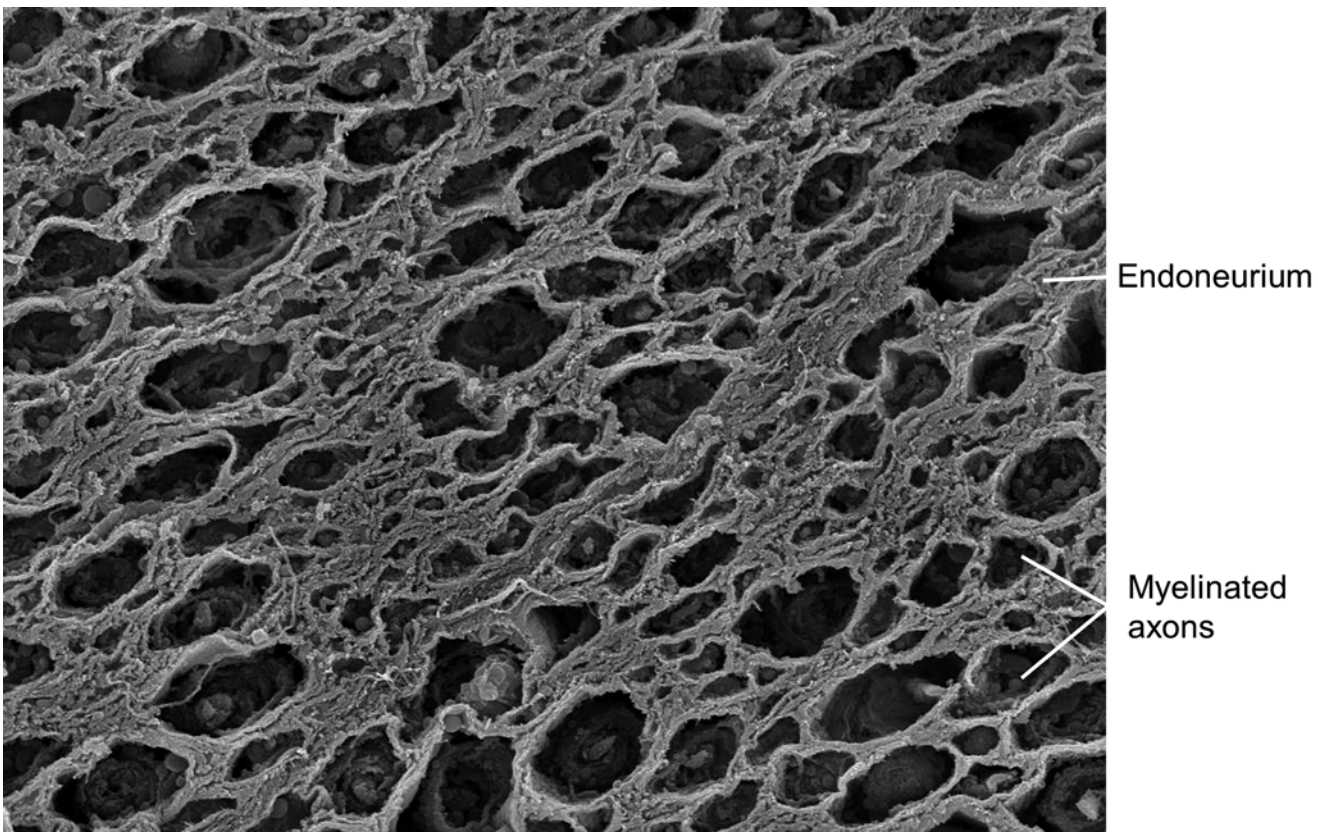

Fig. 3.8 Endoneurium. Myelinated axons enveloped by endoneurium. The sample was obtained from a human sciatic nerve. This technique cannot be used to identify unmyelinated axons. Scanning electron microscopy, magnification: ×1,000

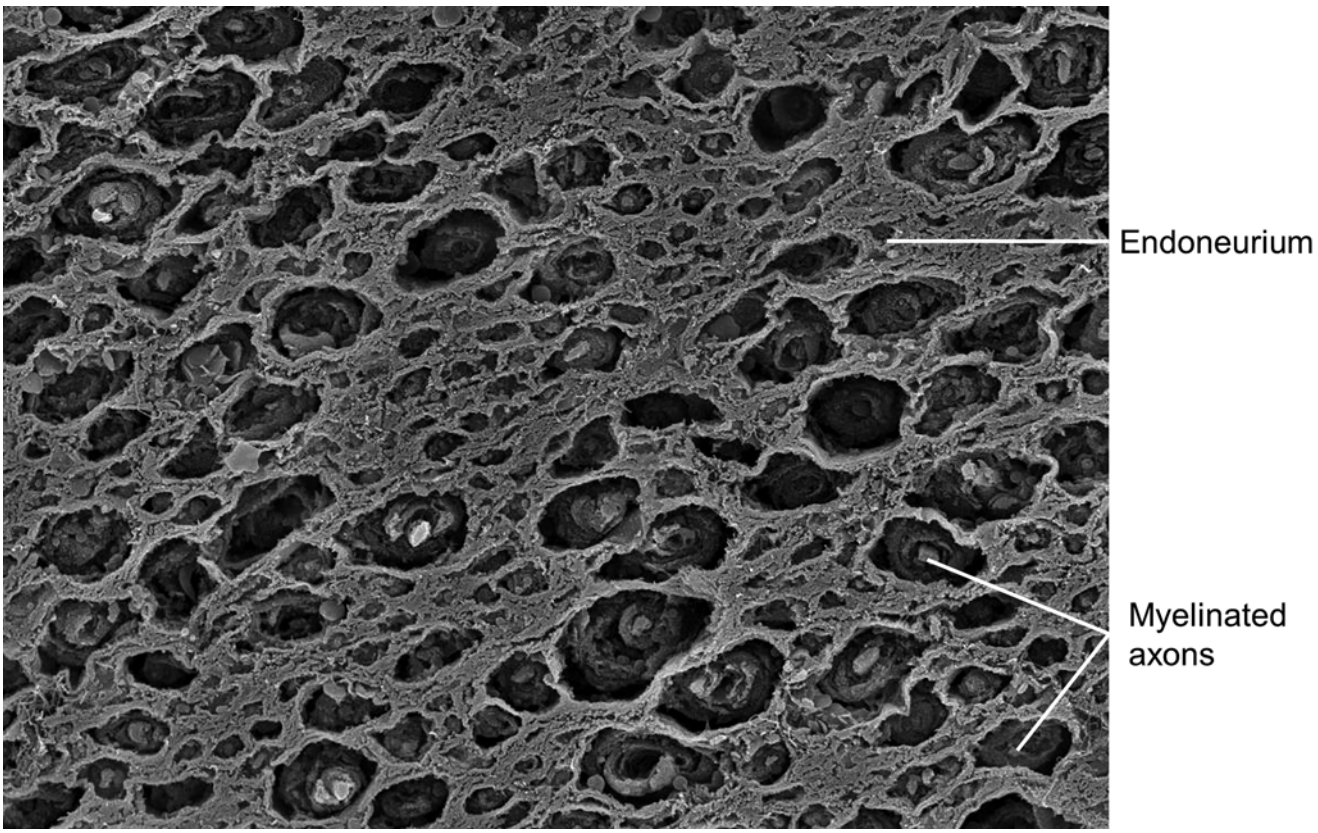

Fig. 3.9 Endoneurium. Myelinated axons enveloped by endoneurium. The sample was obtained from a human sciatic nerve. This technique cannot be used to identify unmyelinated axons. Scanning electron microscopy, magnification: ×1,000

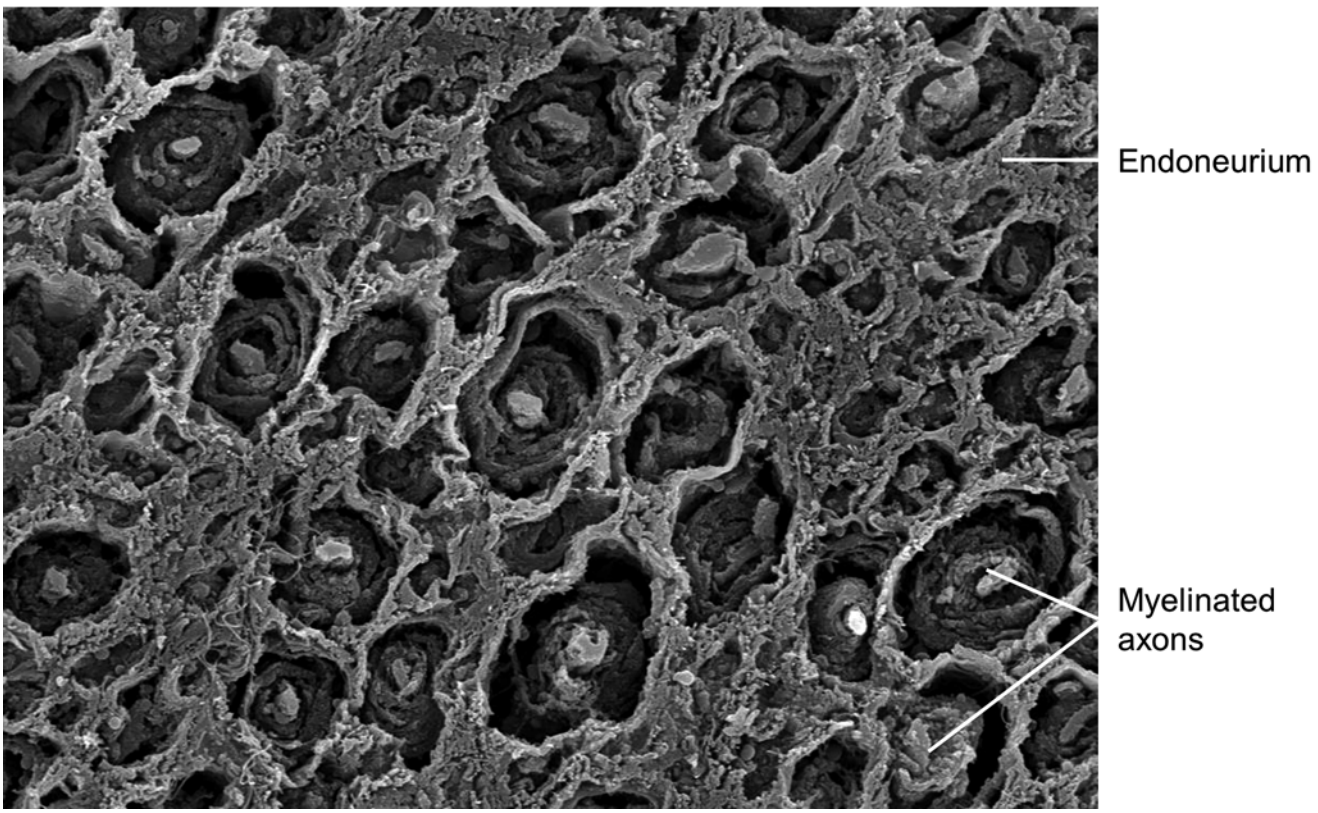

Fig. 3.10 Endoneurium. Myelinated axons enveloped by endoneurium. The sample was obtained from a human sciatic nerve. This technique cannot be used to identify unmyelinated axons. Scanning electron microscopy, magnification: ×1,500

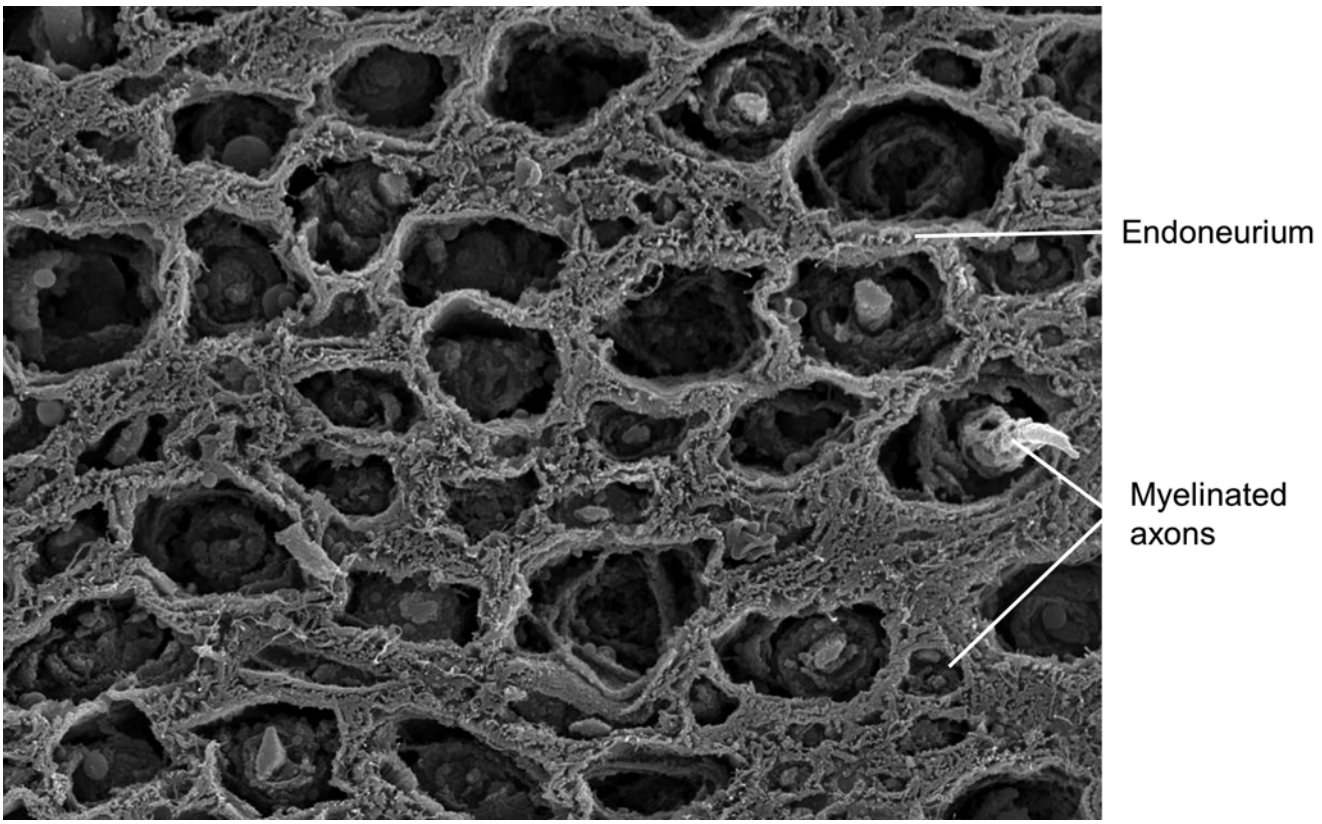

Fig. 3.11 Endoneurium. Myelinated axons enveloped by endoneurium. The sample was obtained from a human sciatic nerve. This technique cannot be used to identify unmyelinated axons. Scanning electron microscopy, magnification: ×1,500

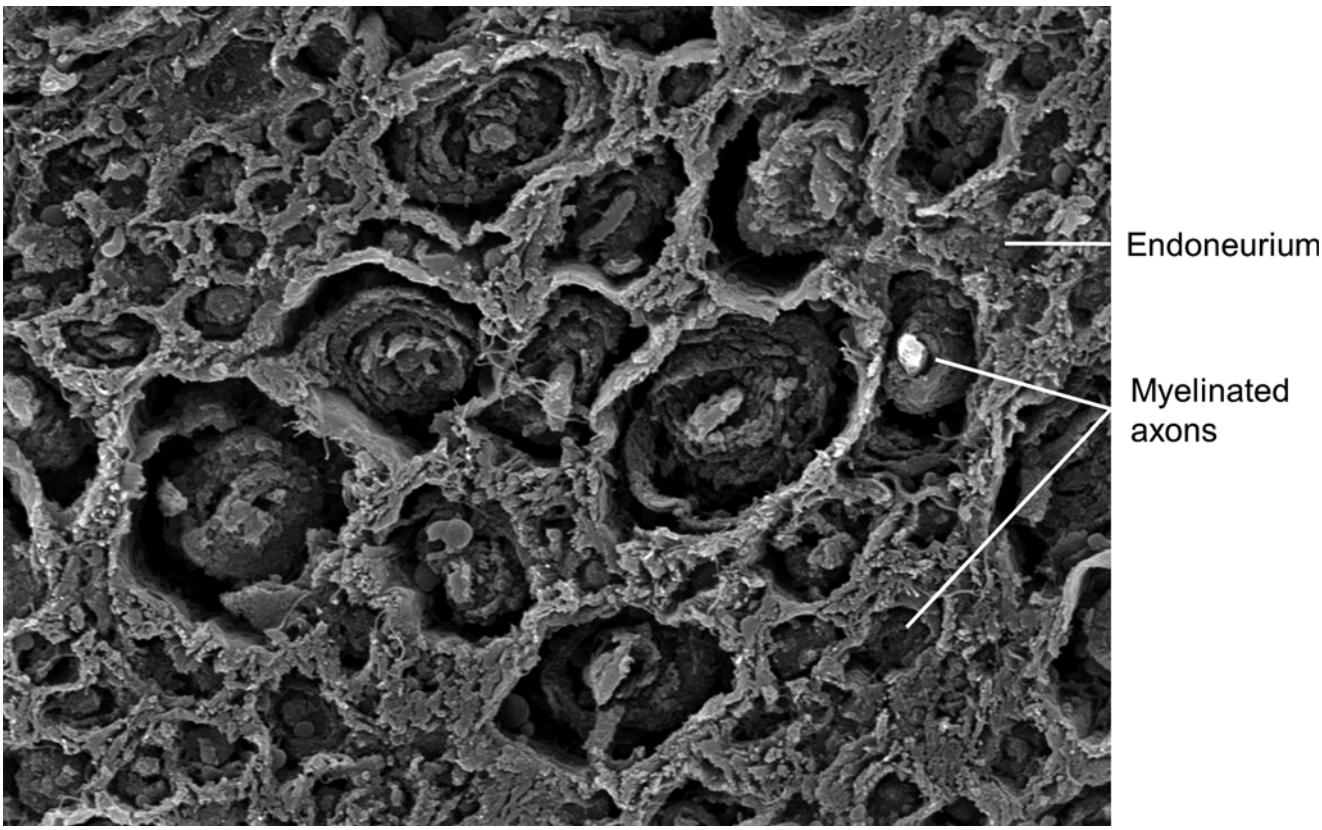

Fig. 3.12 Endoneurium. Myelinated axons enveloped by endoneurium. The sample was obtained from a human sciatic nerve. This technique cannot be used to identify unmyelinated axons. Scanning electron microscopy, magnification: ×2,000

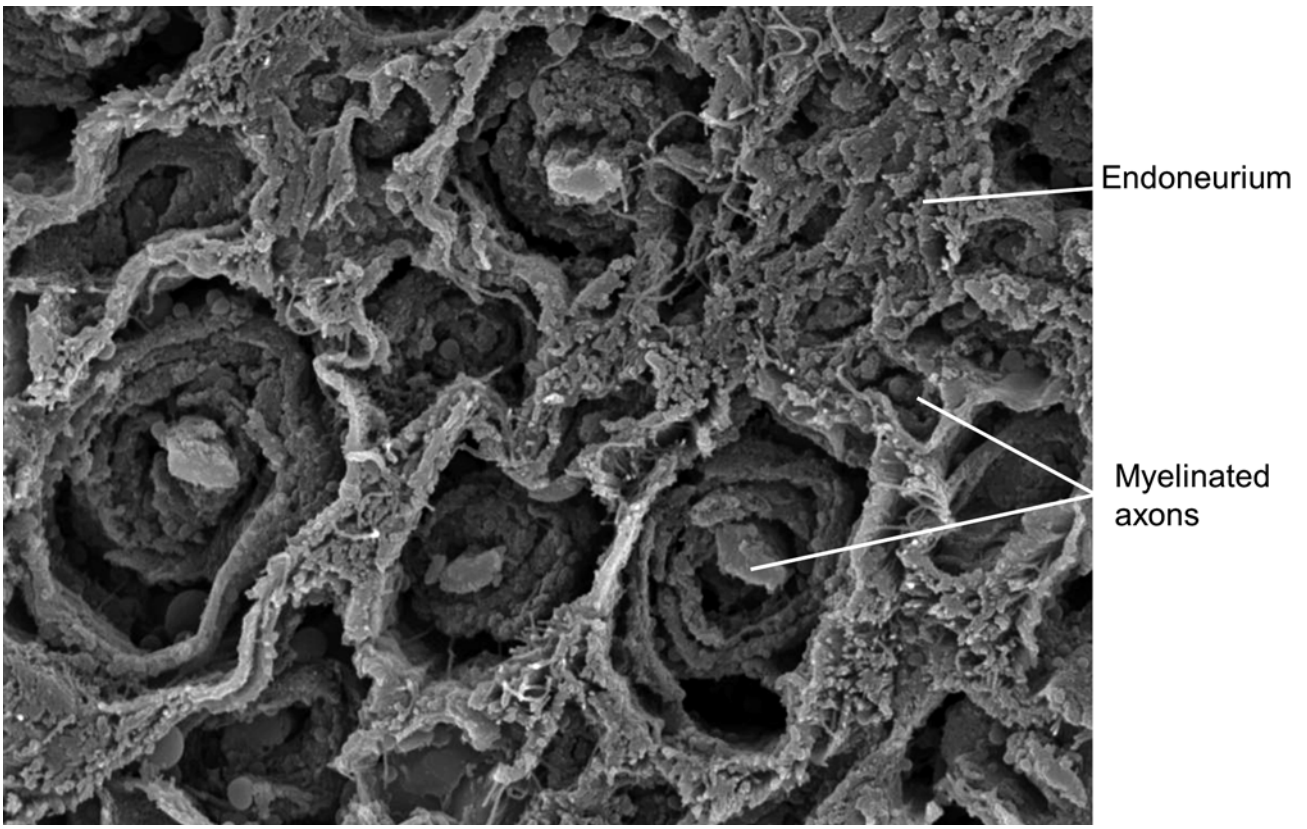

Fig. 3.13 Endoneurium. Myelinated axons enveloped by endoneurium. The sample was obtained from a human sciatic nerve. This technique cannot be used to identify unmyelinated axons. Scanning electron microscopy, magnification: ×3,000

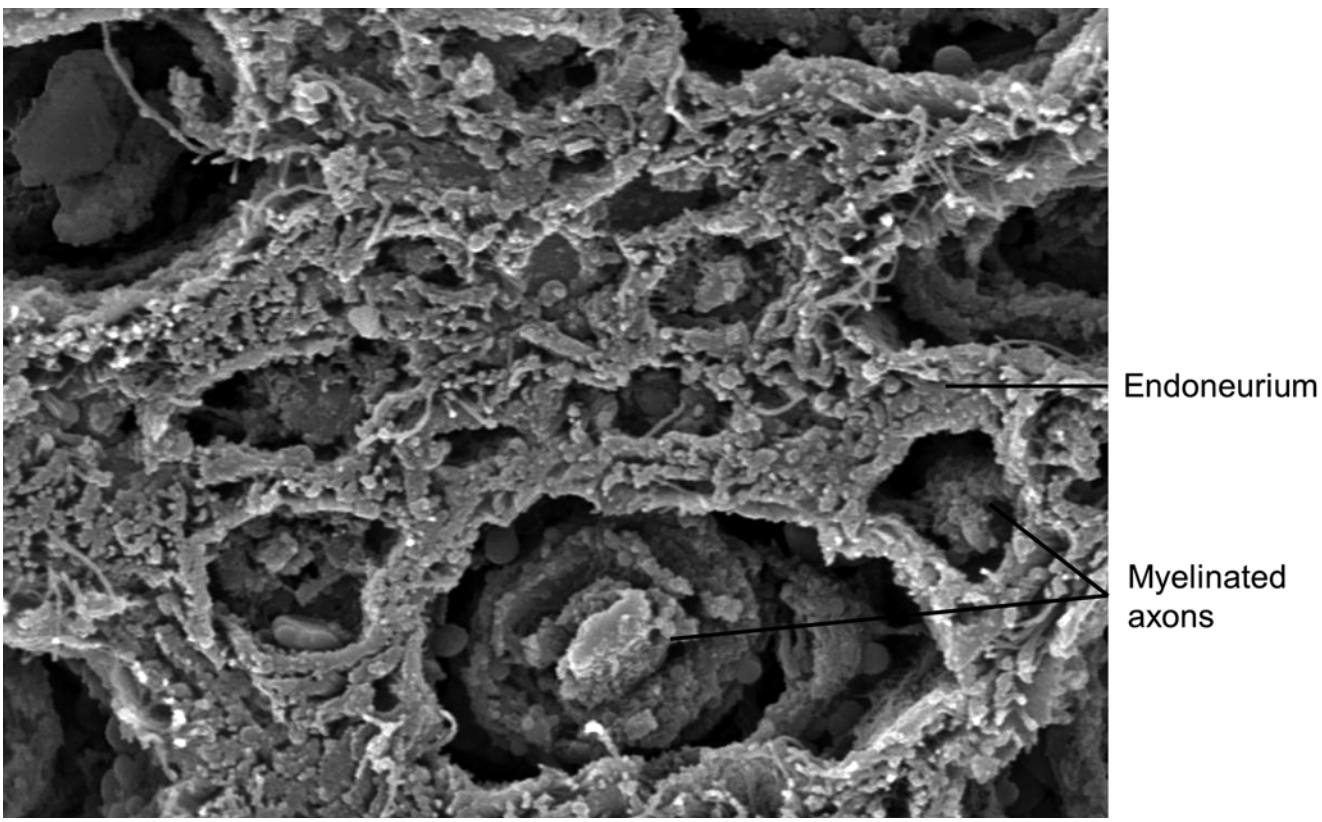

Fig. 3.14 Endoneurium. Myelinated axons enveloped by endoneurium. The sample was obtained from human sciatic nerve. This technique cannot be used to identify unmyelinated axons. Scanning electron microscopy, magnification: ×4,500

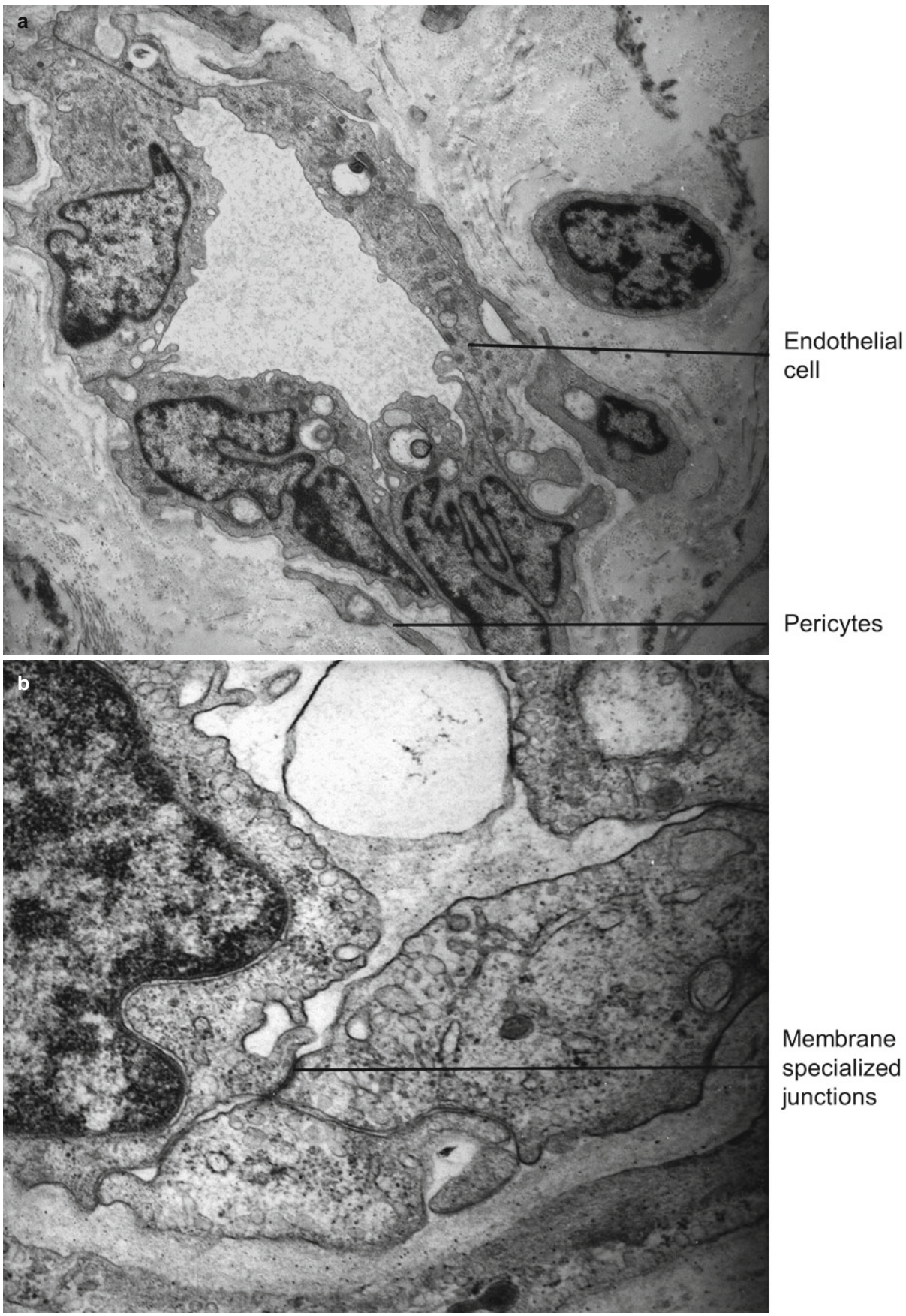

Fig. 3.15 Endoneurium. Endoneural continuous capillaries. Transmission electron microscopy, magnification: ×7,000 (**a**); ×20,000 (**b**)

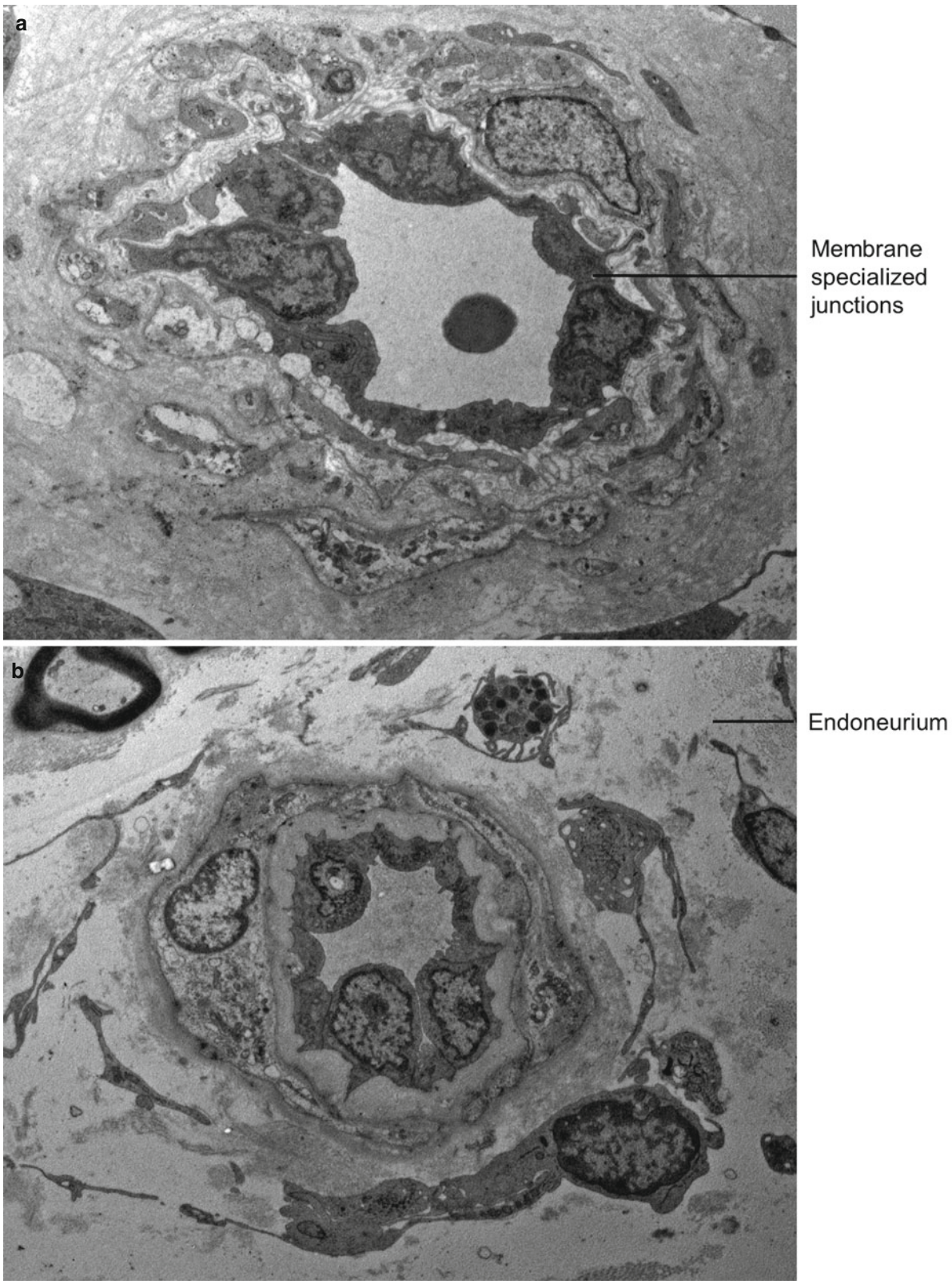

Fig. 3.16 Endoneurium. Endoneural continuous capillaries. Transmission electron microscopy, magnification: ×5,000 (**a**, **b**)

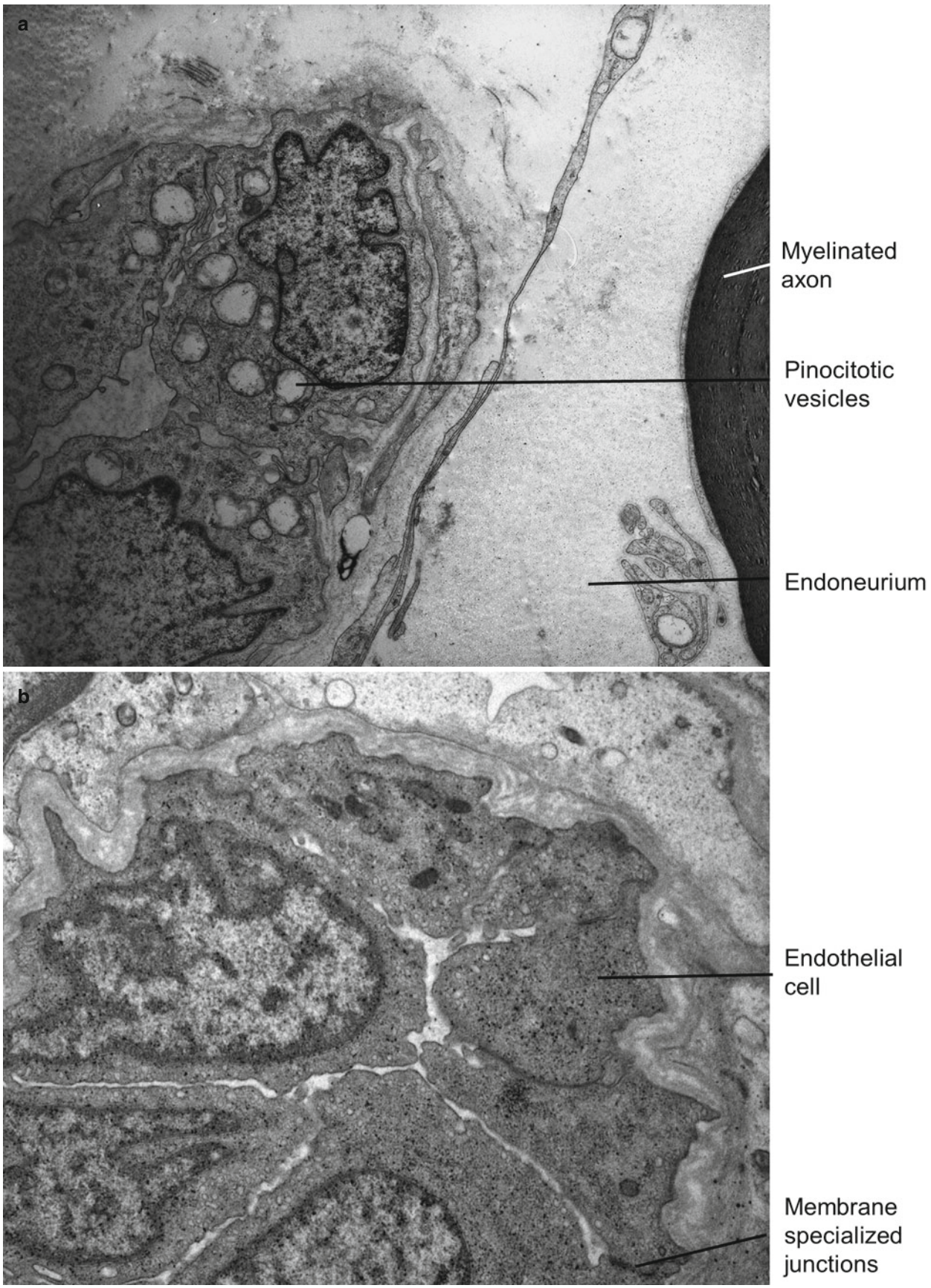

Fig. 3.17 Endoneurium. Endoneural continuous capillaries. Transmission electron microscopy, magnification: ×7,000 (**a**, **b**)

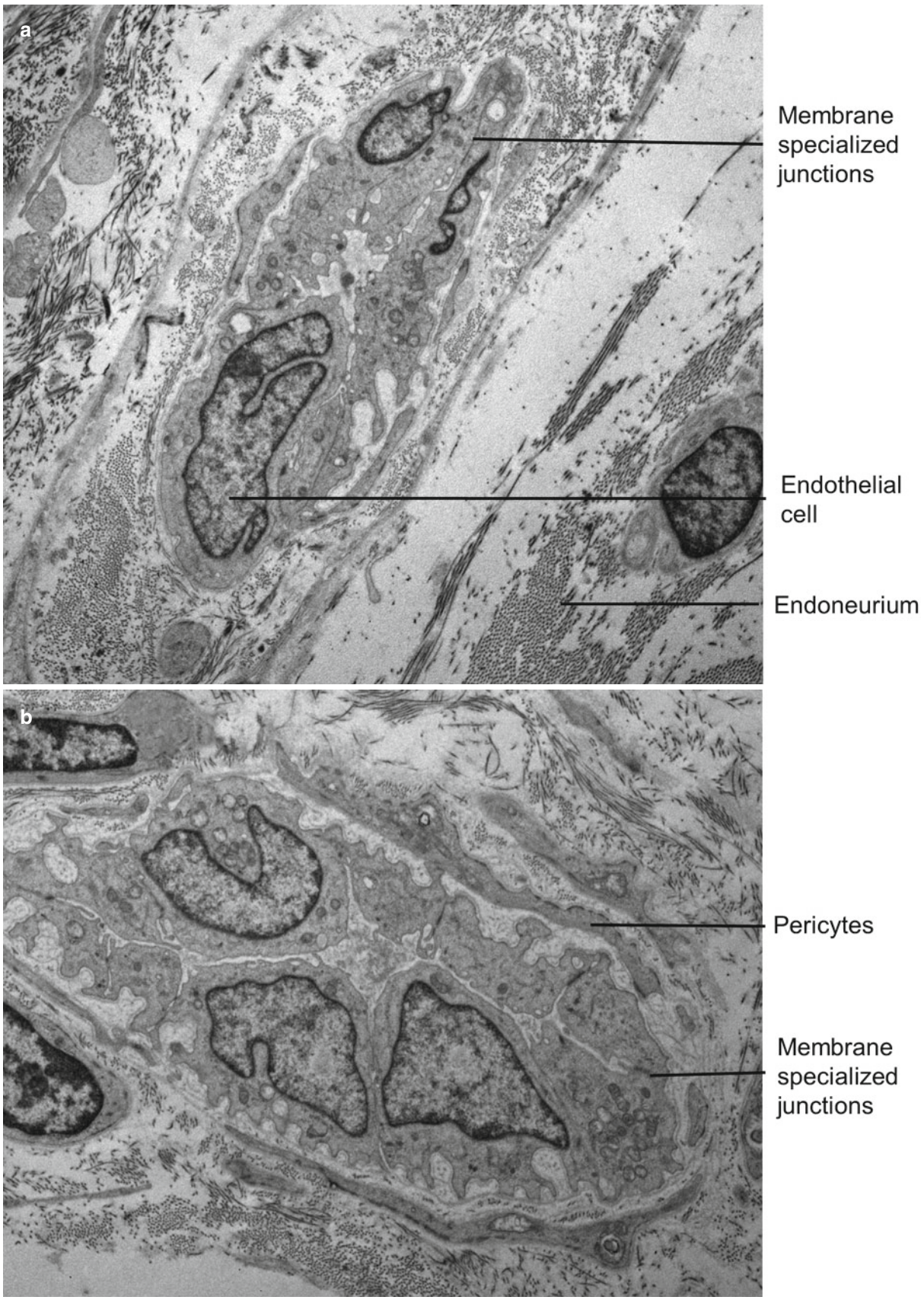

Fig. 3.18 Endoneurium. Endoneural continuous capillaries. Transmission electron microscopy, magnification: ×6,000 (**a**); ×8,000 (**b**)

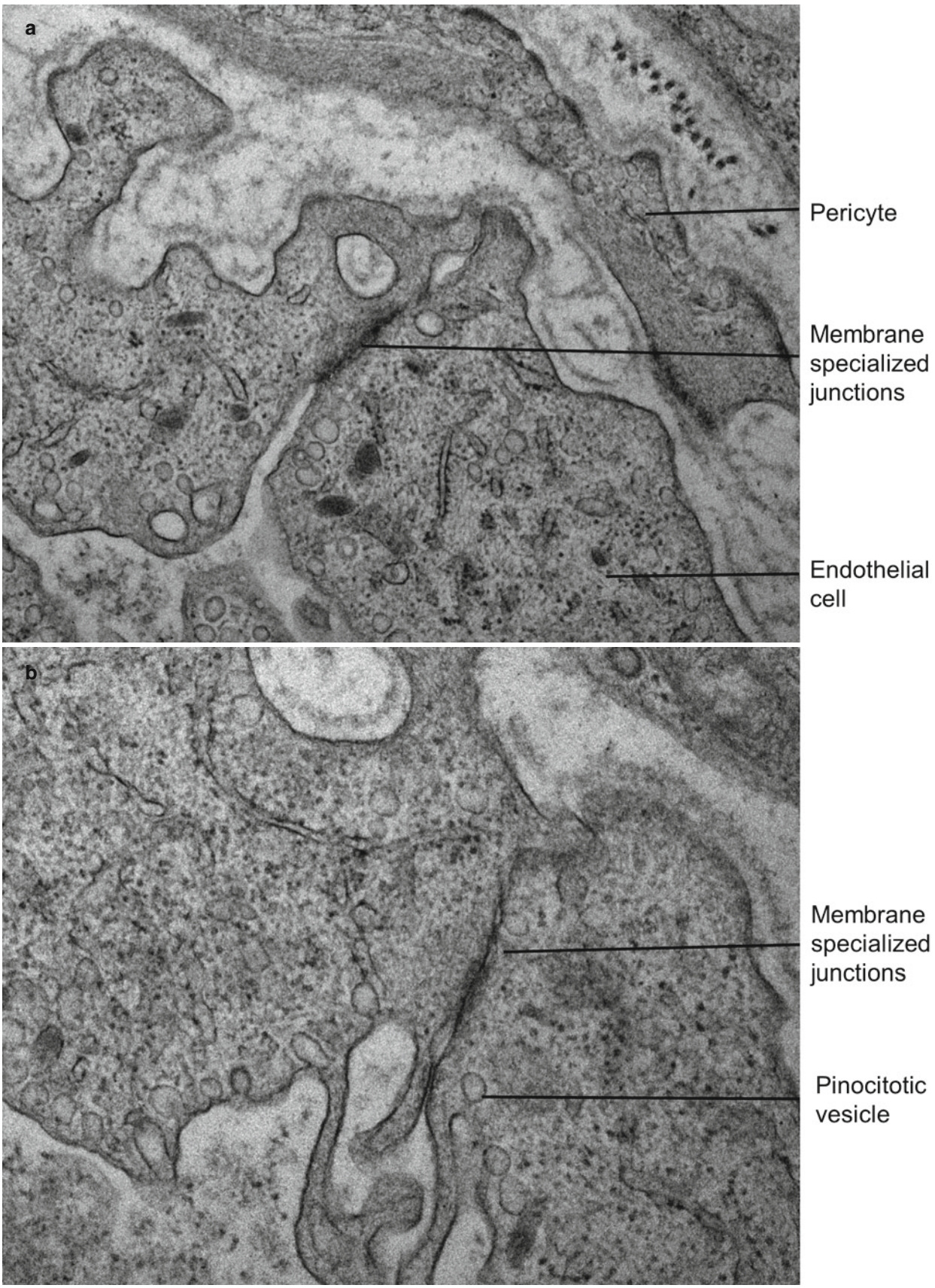

Fig. 3.19 Endoneurium. Endoneural continuous capillaries. Shown are details of the specialized membrane junction between endothelial cells. Transmission electron microscopy, magnification: ×40,000 (**a**); ×60,000 (**b**)

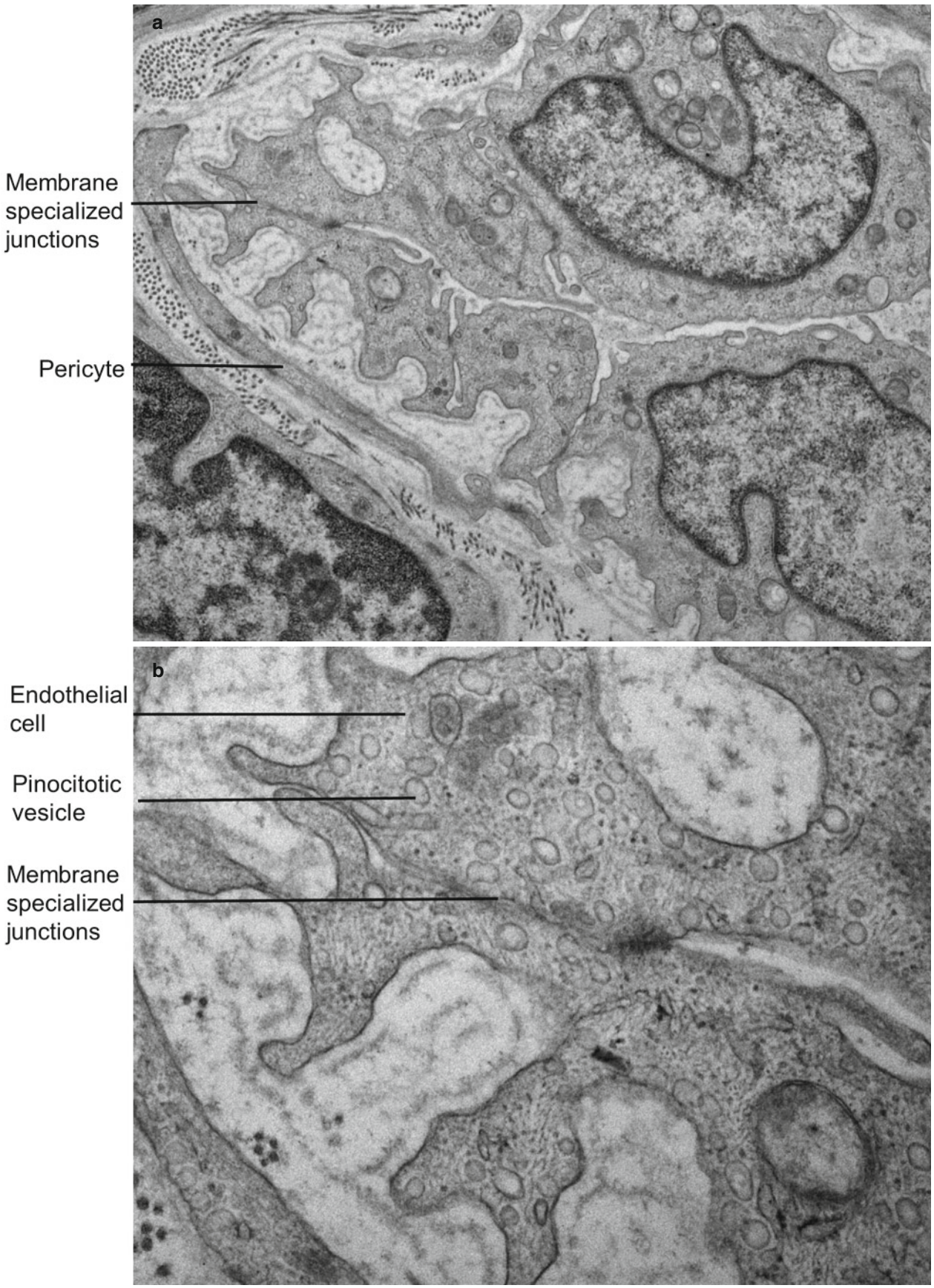

Fig. 3.20 Endoneurium. Endoneural continuous capillaries. Shown are details of the specialized membrane junction between endothelial cells. Transmission electron microscopy, magnification: ×15,000 (**a**); ×50,000 (**b**)

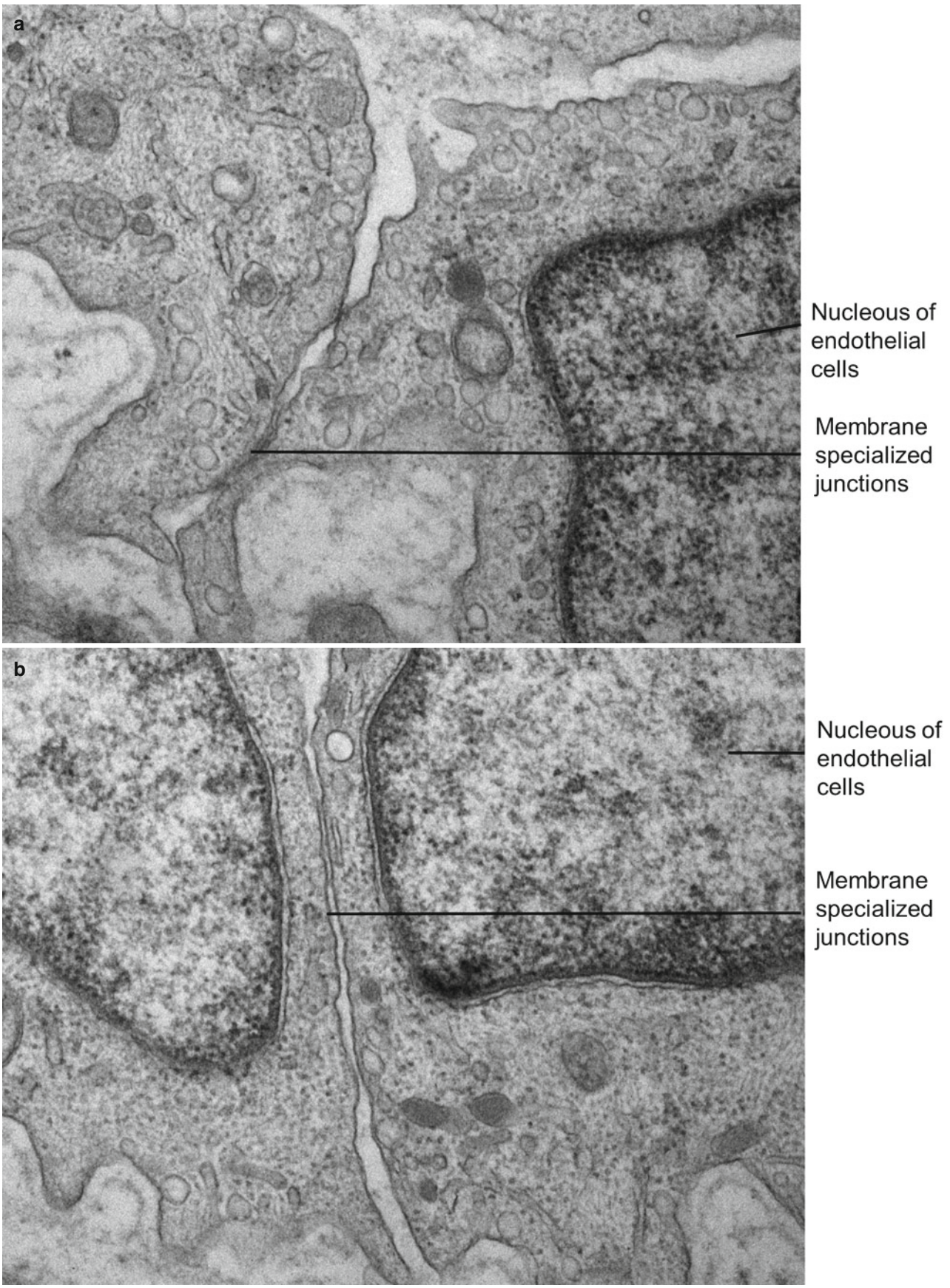

Fig. 3.21 Endoneurium. Endoneural continuous capillaries. Shown are details of the specialized membrane junction between endothelial cells. Transmission electron microscopy, magnification: ×50,000 (**a**, **b**)

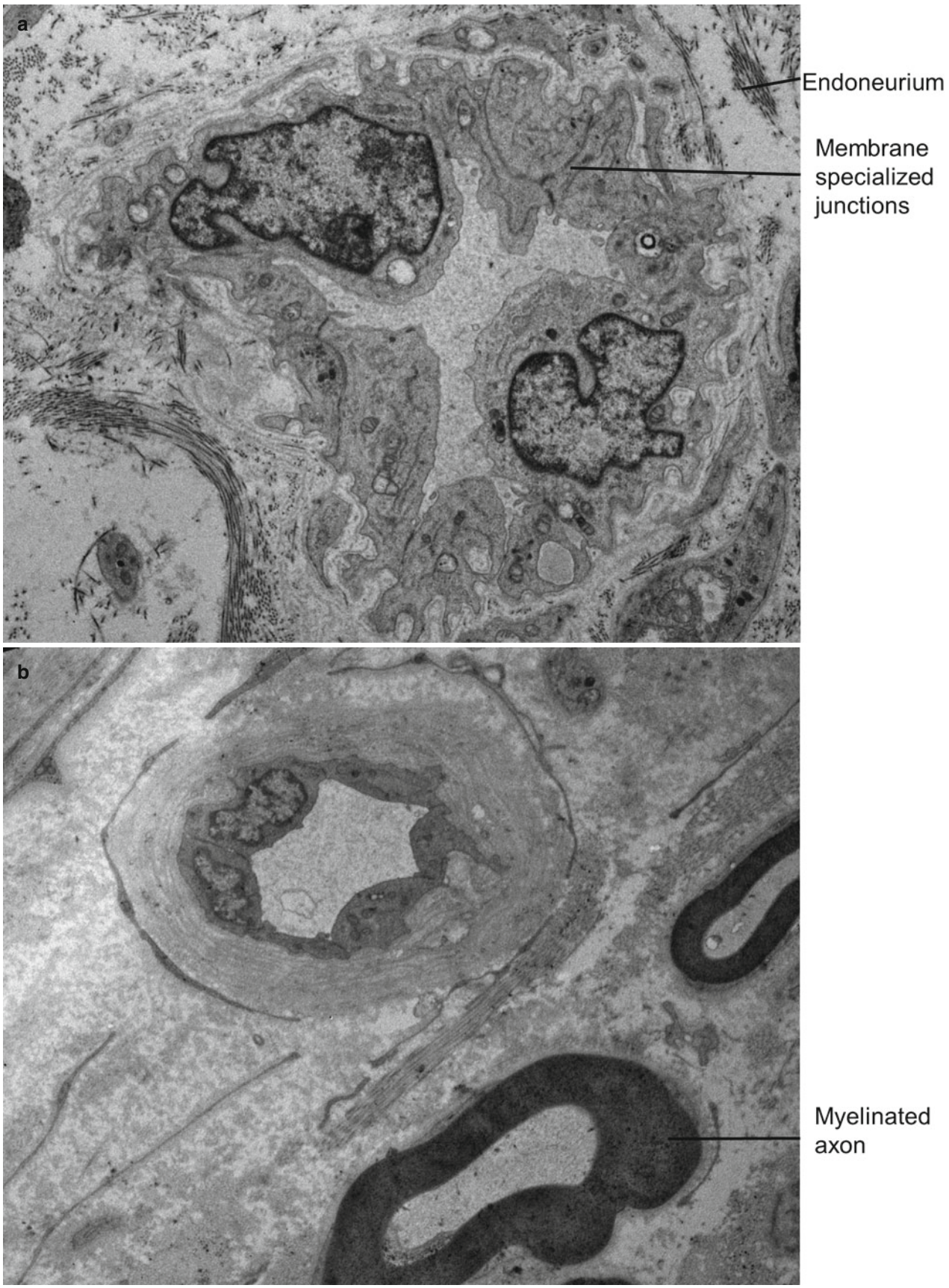

Fig. 3.22 Endoneurium. Endoneural continuous capillaries. Transmission electron microscopy, magnification: ×8,000 (**a**); ×7,000 (**b**)

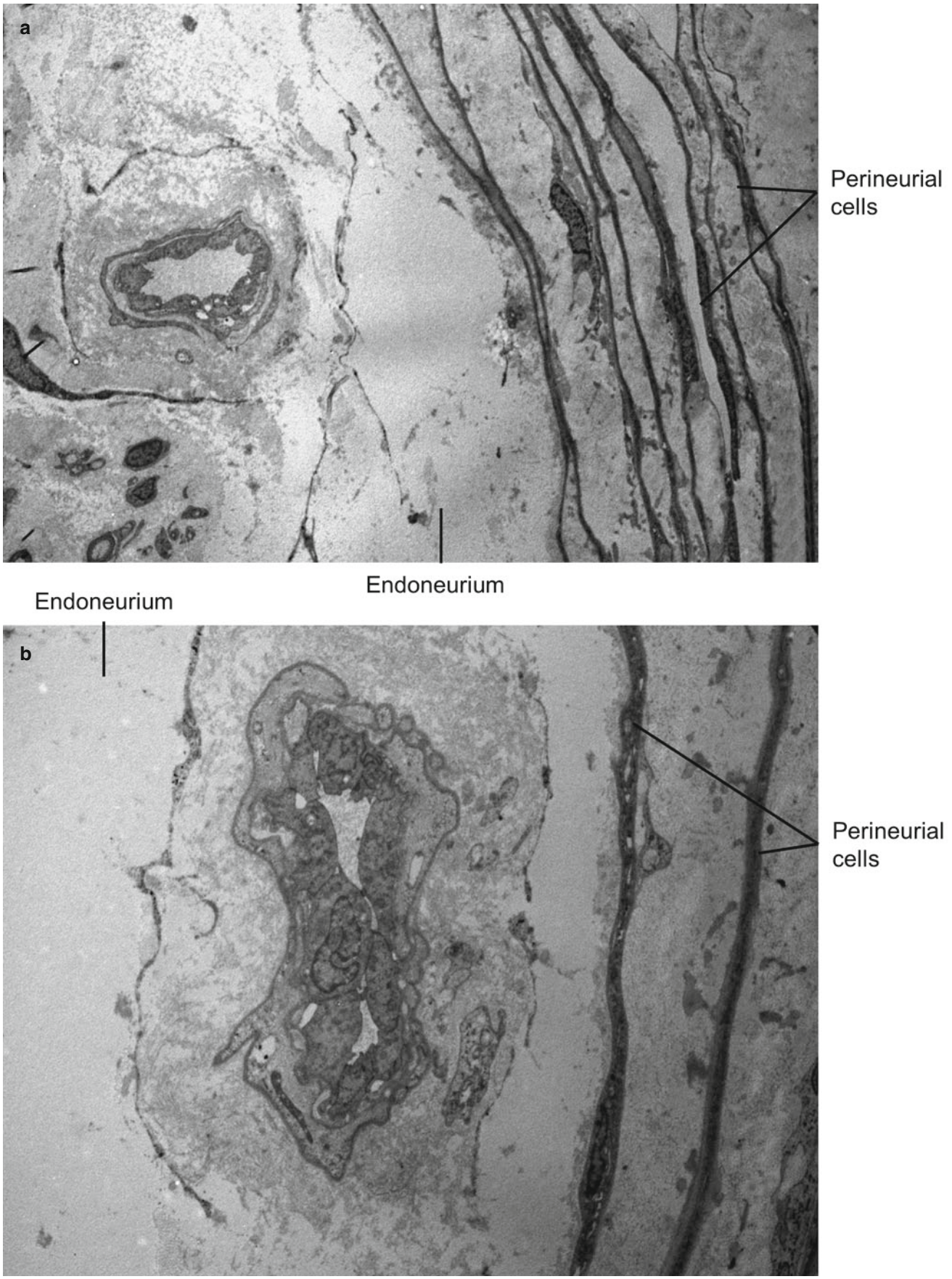

Fig. 3.23 Endoneurium. Endoneural continuous capillaries. Transmission electron microscopy, magnification: ×2,500 (**a**); ×6,000 (**b**)

References

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