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In the past, the arachnoid layer had been defined as a fine membrane in contact with (but not adhering to) the internal surface of the dura mater, and the subdural space had been described as a virtual space between the arachnoid layer and the dura mater, but this concept has since been modified. (See Chaps. 26 and 27). The arachnoid layer, a semipermeable membrane, exerts a barrier effect against the passage of substances across it. The thickness of the arachnoid measures about 35–40 μm , and it is composed of cells strongly bonded by specific membrane junctions [1–4]. The intercellular space is thought to contain collagen fibers that reinforce this structure in order to increase its mechanical resistance. From the outer towards the inner aspect of this membrane, four differentiated structures can be observed:

- The outermost area is occupied by neurothelial cells, also known as dural border cells of the subdural com-

partment, which become the limits of “acquired subdural spaces” as the process of tearing extends across this layer.

- Collagen fibers oriented in various directions compose the second distinctive area, occupying about 40–50 % of the total thickness of the arachnoid.
- A basal membrane limits a third area filled with arachnoid cells that exert a barrier effect against the passage of substances. This layer comprises four or five cellular planes. These cells are light-colored and elongated, with a thickness of about 1.5–2 μm . The nucleus of these cells is large (1 μm wide by 7–9 μm); in their cytoplasm, the matrix contains fine reticular filaments oriented in different directions, endoplasm, numerous vesicles, and some mitochondria and lysosomes, with a few heterochromatin aggregates. The intercellular space is minimal in areas exerting barrier effect, forming narrow clefts of about 0.02–0.03 μm . Plasma membranes of neighboring cells join together by means of different types of specialized unions, such as tight junctions and desmosomes. The intercellular space lacks collagen, elastic fibers, or microfibrils.
- The innermost area lies in direct contact with cerebrospinal fluid (CSF) and is formed by the reticular arachnoid, where arachnoid cells limit the subarachnoid space [5]. The intercellular space among these cells gradually increases owing to the absence of specialized membrane junctions, giving rise to small intercellular gaps that constitute the trabecular arachnoid extending across the subarachnoid space (Figs. 21.1, 21.2, 21.3, 21.4, 21.5, 21.6, 21.7, 21.8, 21.9, 21.10, 21.11, 21.12, 21.13, 21.14, 21.15, 21.16, 21.17, 21.18, 21.19, 21.20, 21.21, 21.22, 21.23, and 21.24).

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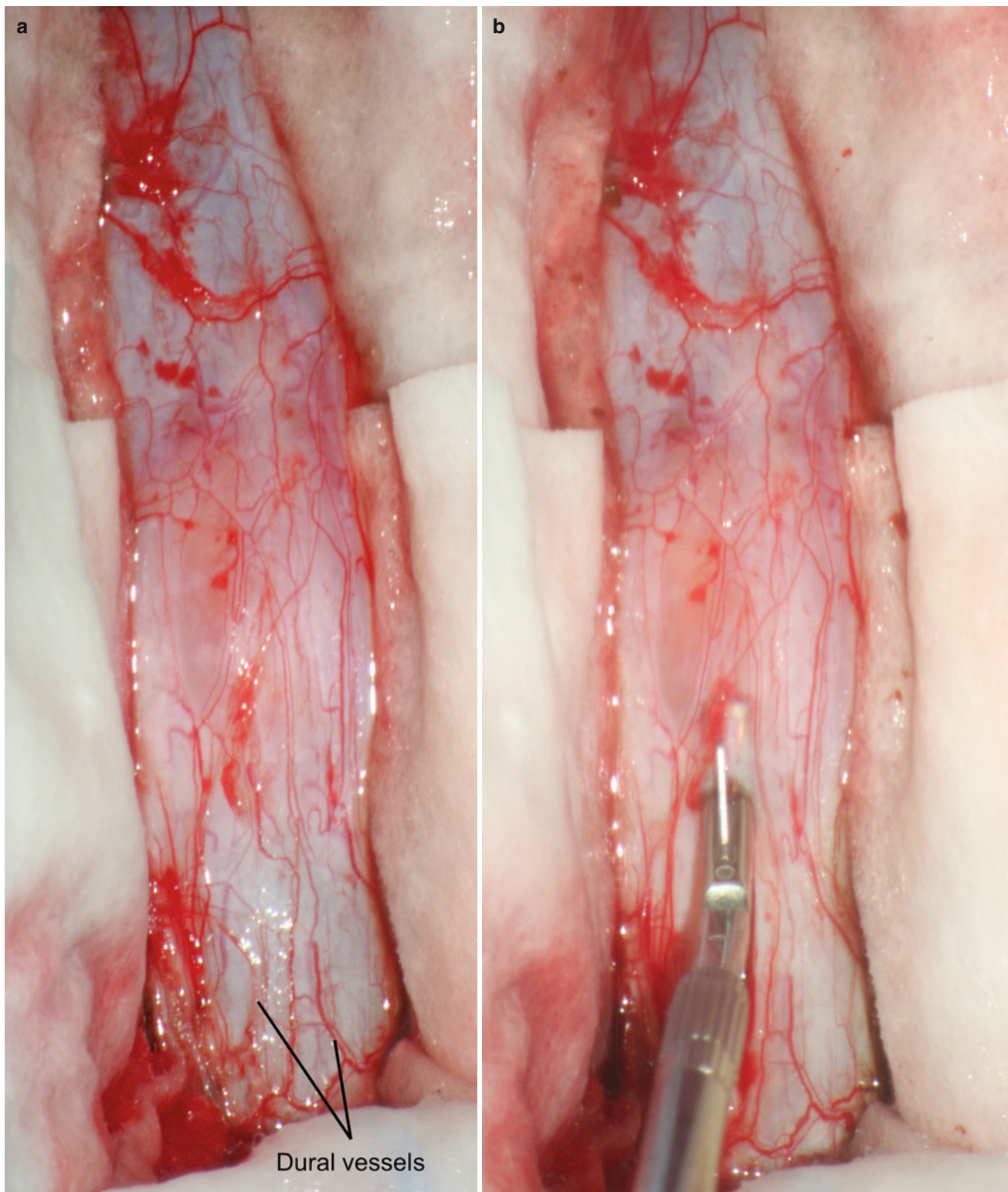


Fig. 21.1 Dissection of human dural sac during neurosurgical intervention (b from Reina et al. [1]; with permission)

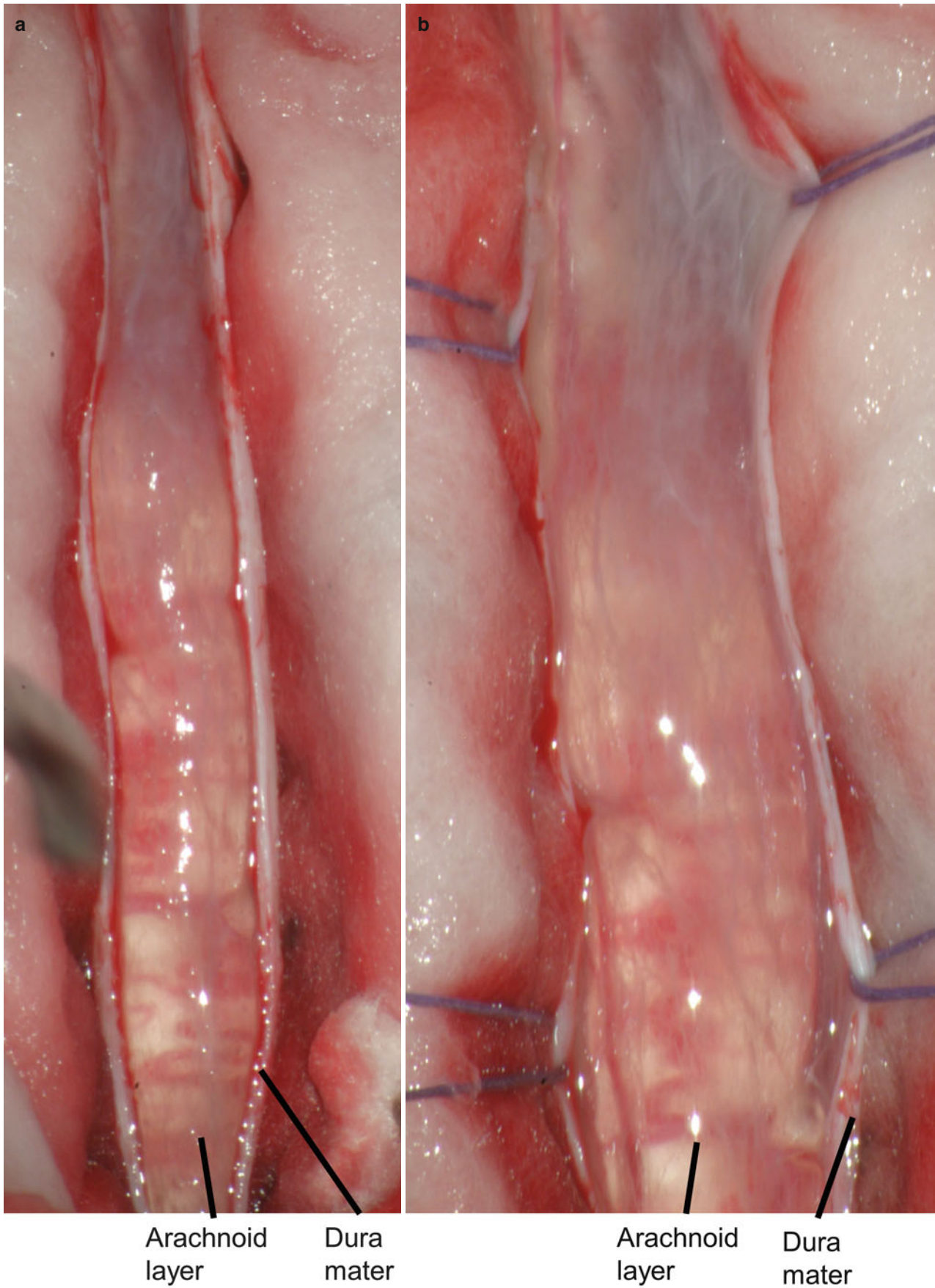


Fig. 21.2 View of human spinal arachnoid layer during neurosurgical intervention (**b** from Reina et al. [1]; with permission)

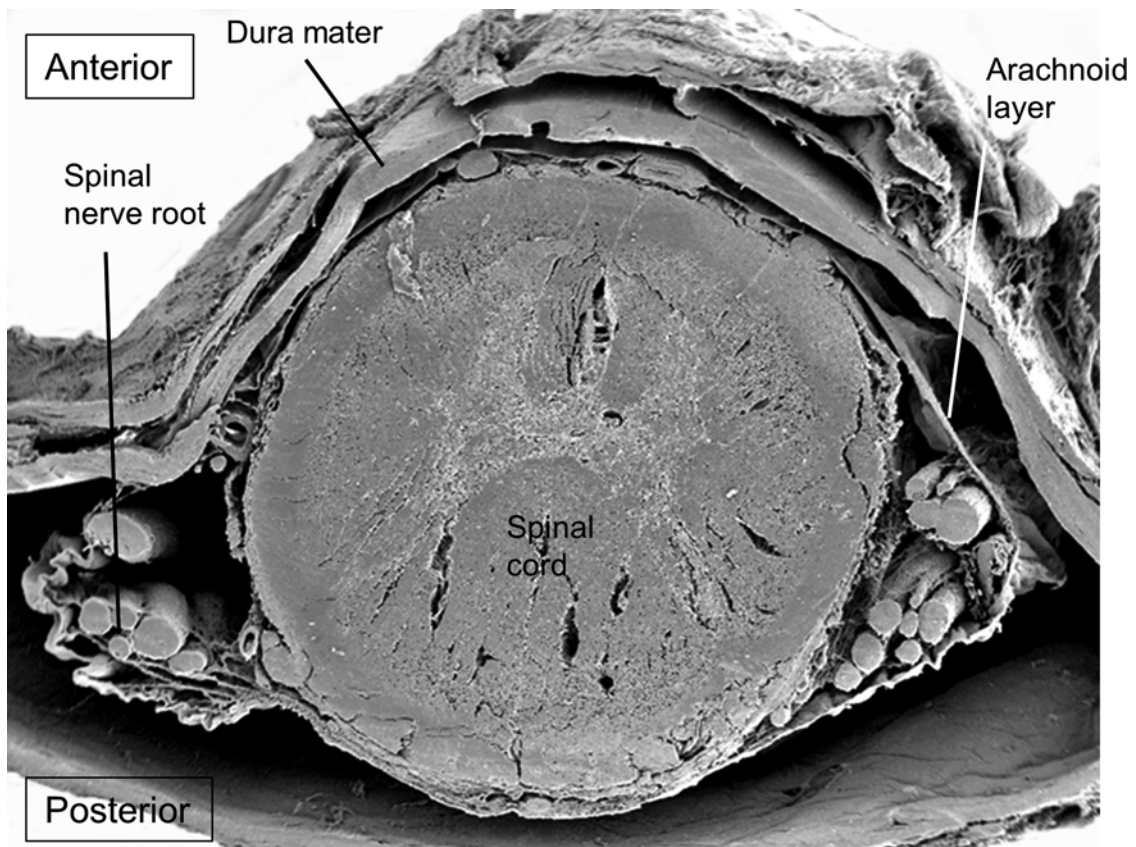


Fig. 21.3 Spinal arachnoid layer. Transverse section of human spinal dural sac and spinal cord. Scanning electron microscopy. Magnification $\times 10$ (From De Andrés et al. [5]; with permission)

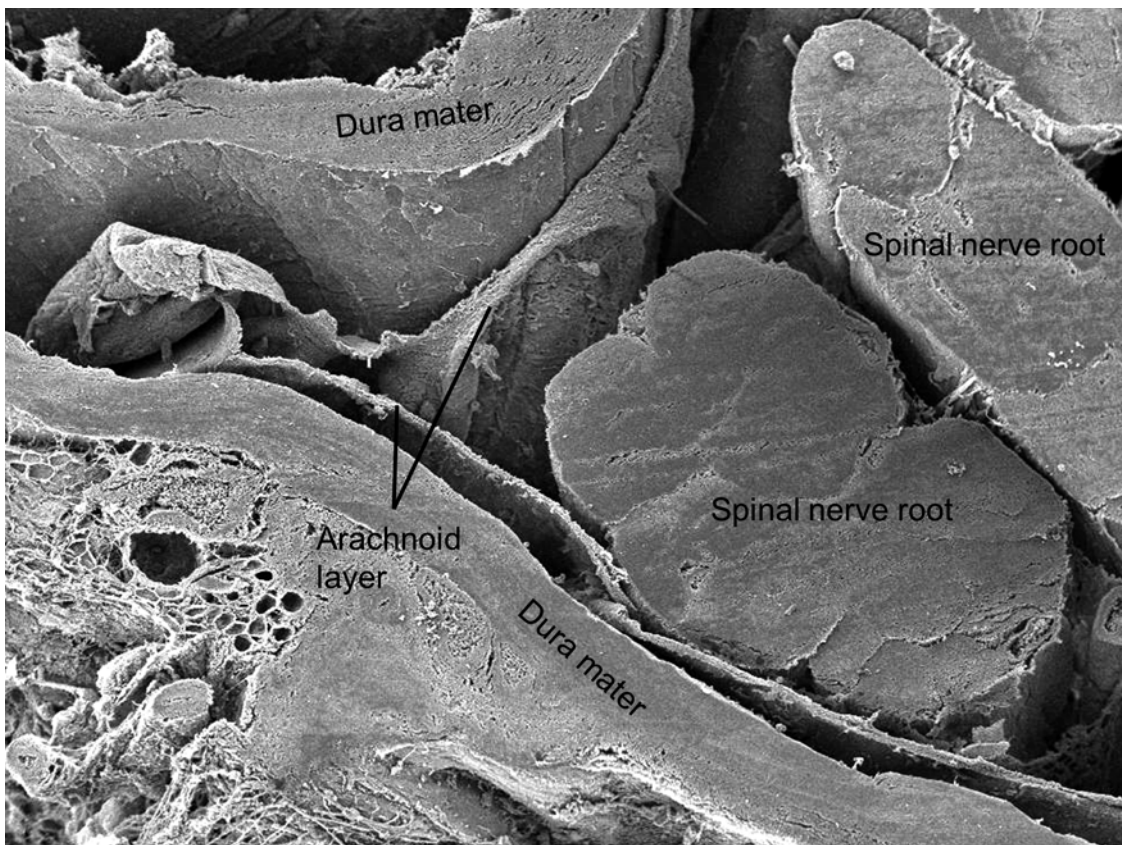


Fig. 21.4 Spinal arachnoid layer. Transverse section of human spinal dural sac and spinal nerve root at lumbar level. Detail of arachnoid layer. Scanning electron microscopy. Magnification $\times 40$

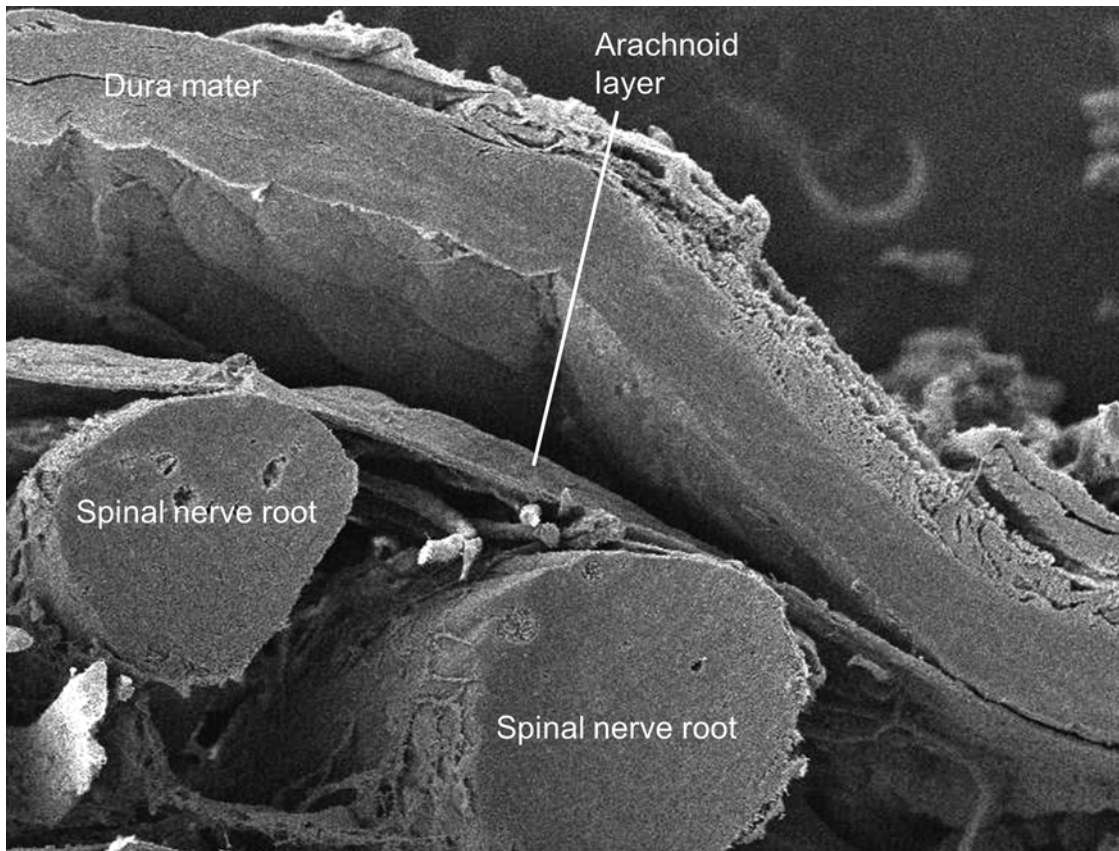


Fig. 21.5 Spinal arachnoid layer. Transverse section of human spinal dural sac and spinal nerve root at lumbar level. Detail of arachnoid layer. Scanning electron microscopy. Magnification $\times 40$

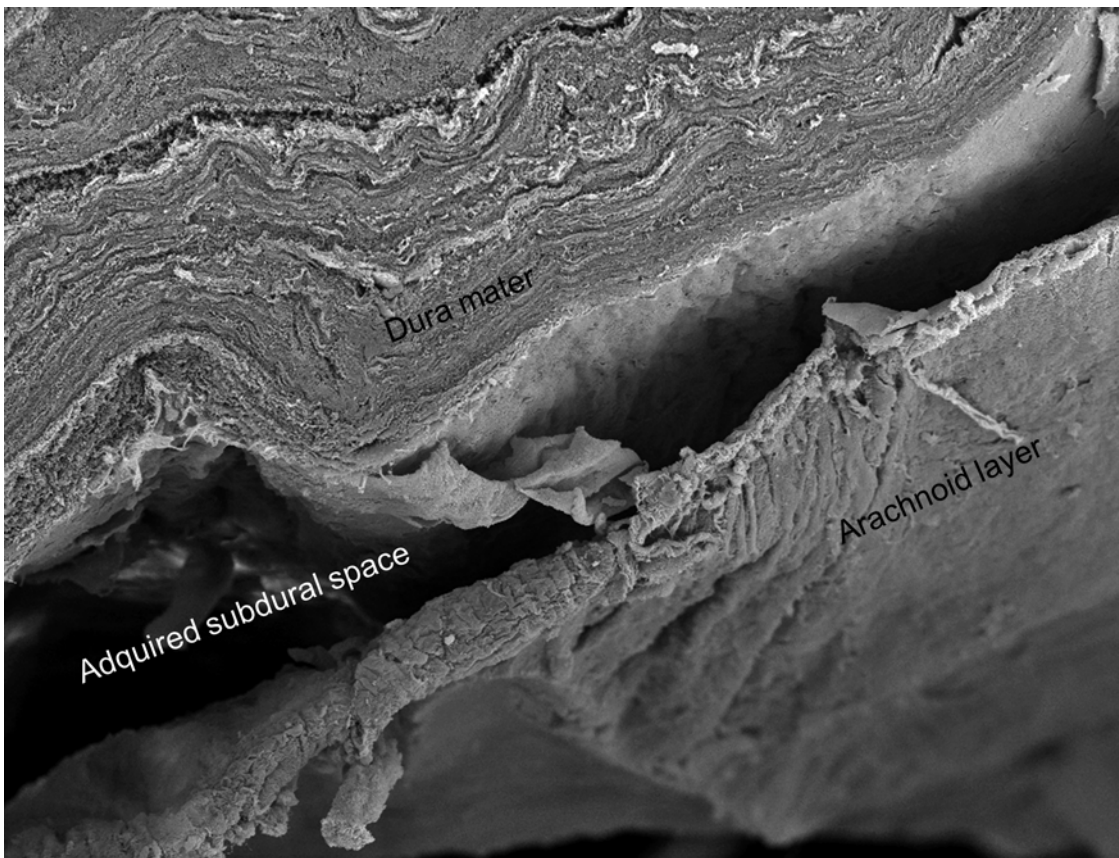


Fig. 21.6 Spinal arachnoid layer. Transverse section of human spinal dural sac and spinal nerve root at lumbar level. Detail of arachnoid layer. Scanning electron microscopy. Magnification $\times 170$ (From Reina et al. [4]; with permission)

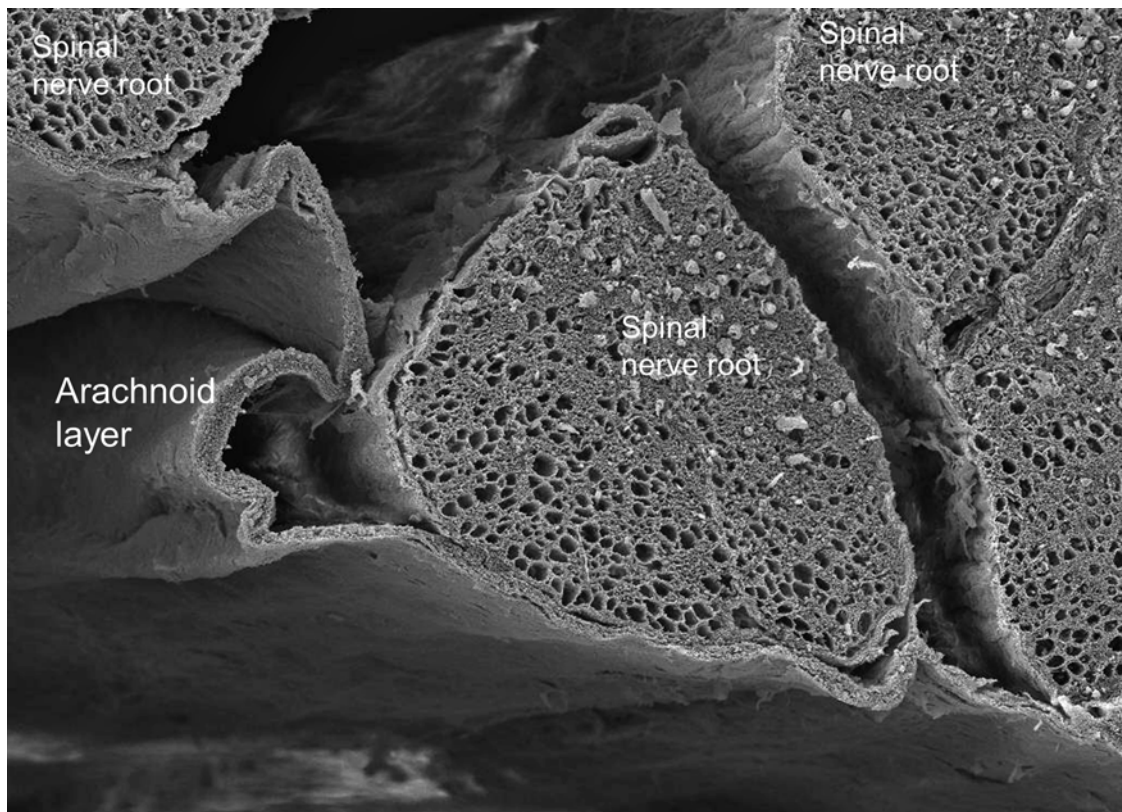


Fig. 21.7 Spinal arachnoid layer. Transverse section of human spinal dural sac and spinal nerve root at lumbar level. Detail of arachnoid layer. Scanning electron microscopy. Magnification $\times 150$

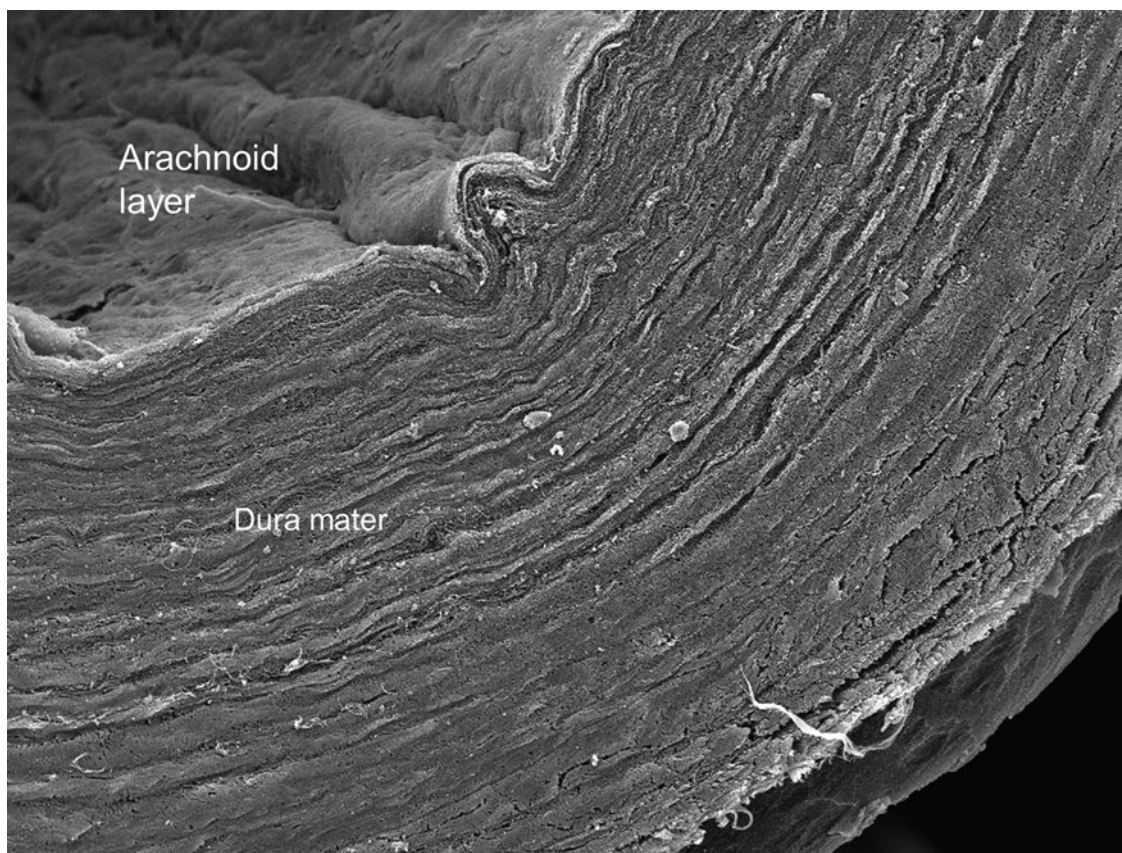


Fig. 21.8 Spinal arachnoid layer. Transverse section of human spinal dural sac at lumbar level. Detail of arachnoid layer. Scanning electron microscopy. Magnification $\times 300$

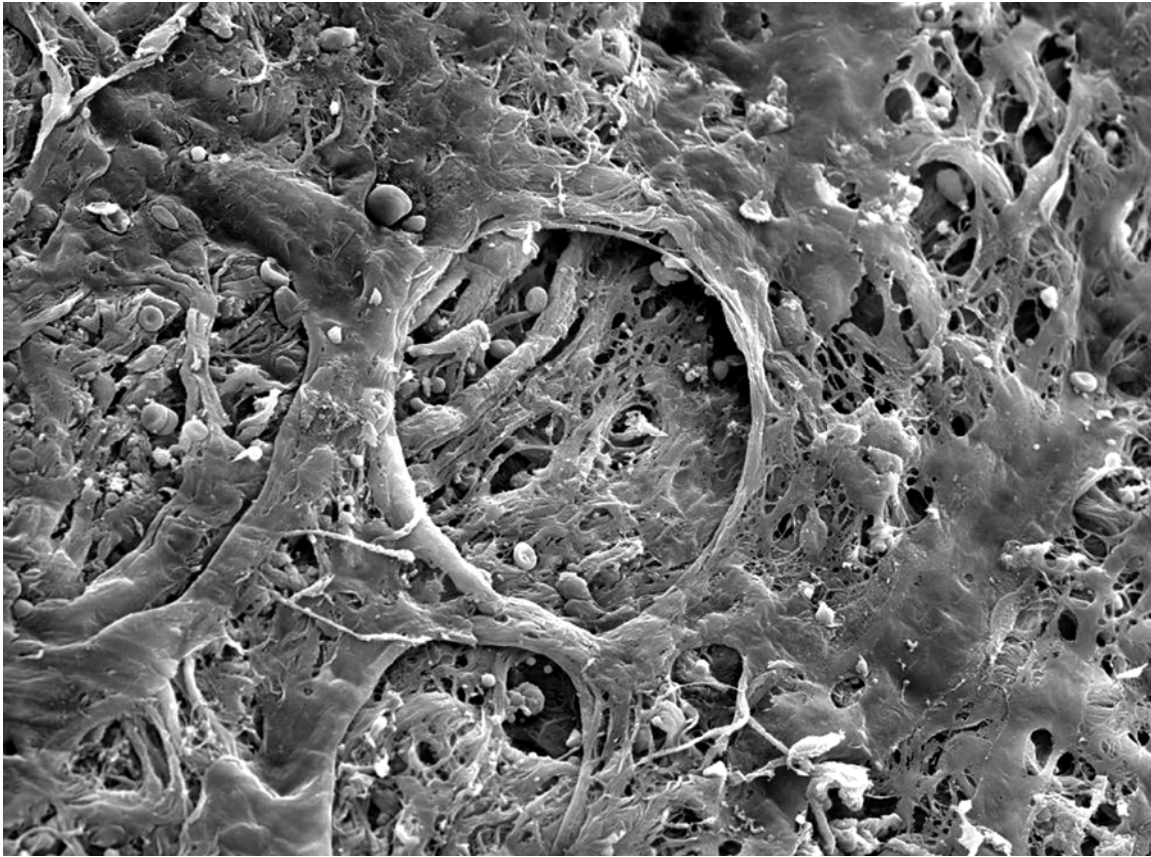


Fig. 21.9 Spinal arachnoid layer. Internal surface of arachnoid layer (internal surface of human spinal dural sac). Scanning electron microscopy. Magnification $\times 500$

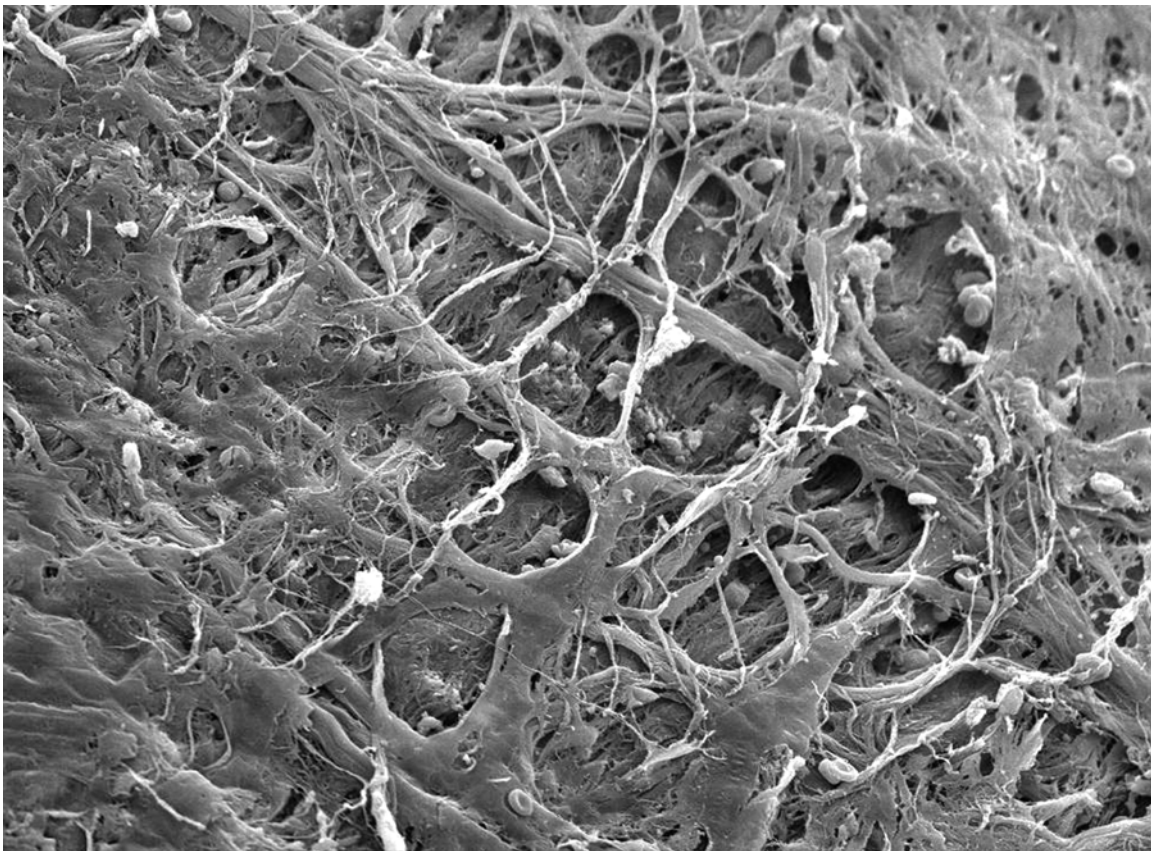


Fig. 21.10 Spinal arachnoid layer. Internal surface of arachnoid layer. Scanning electron microscopy. Magnification $\times 500$

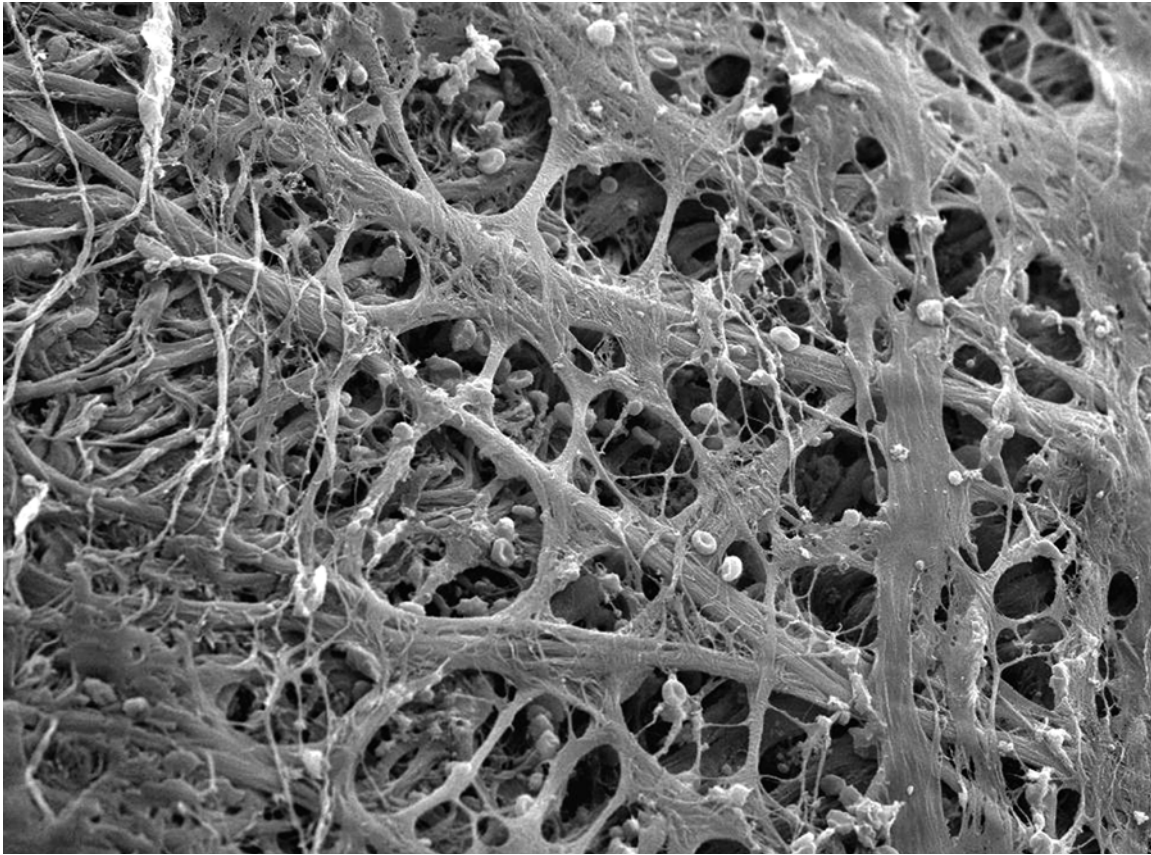


Fig. 21.11 Spinal arachnoid layer. Internal surface of arachnoid layer. Scanning electron microscopy. Magnification $\times 500$

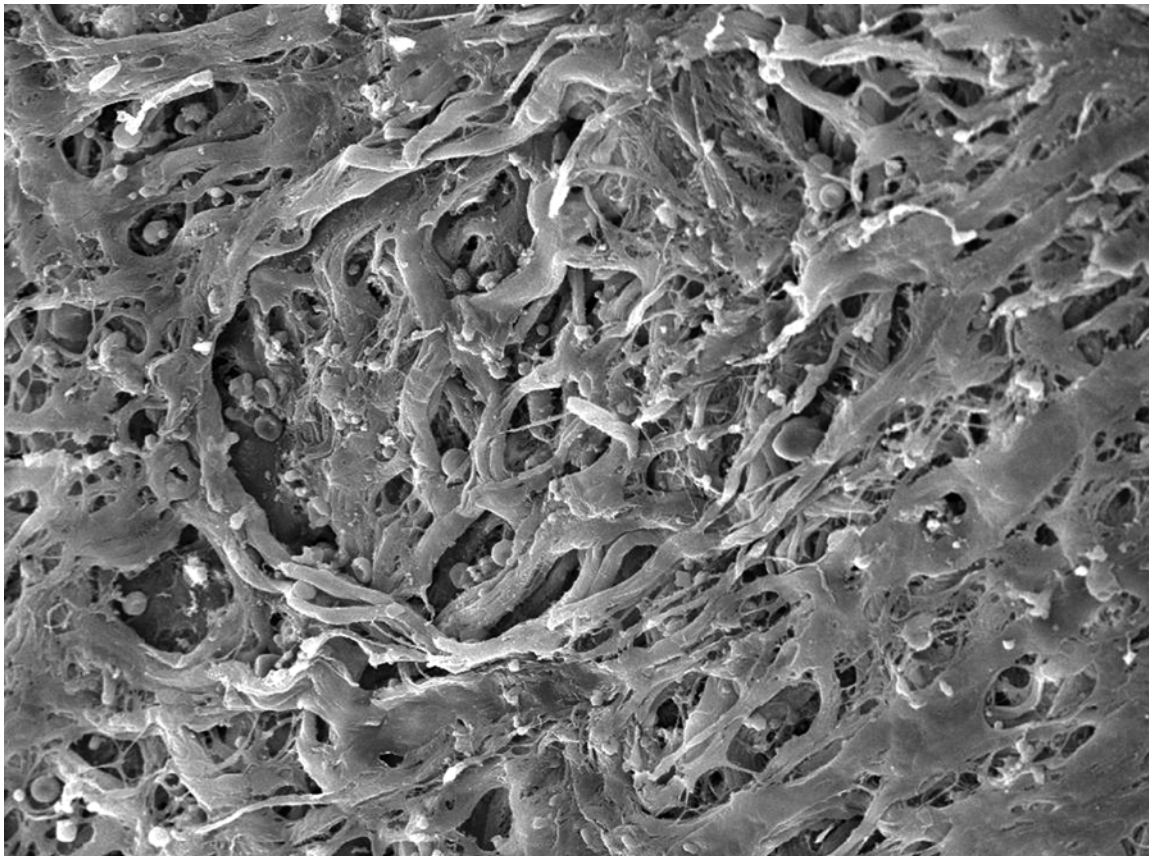


Fig. 21.12 Spinal arachnoid layer. Internal surface of arachnoid layer. Scanning electron microscopy. Magnification $\times 500$

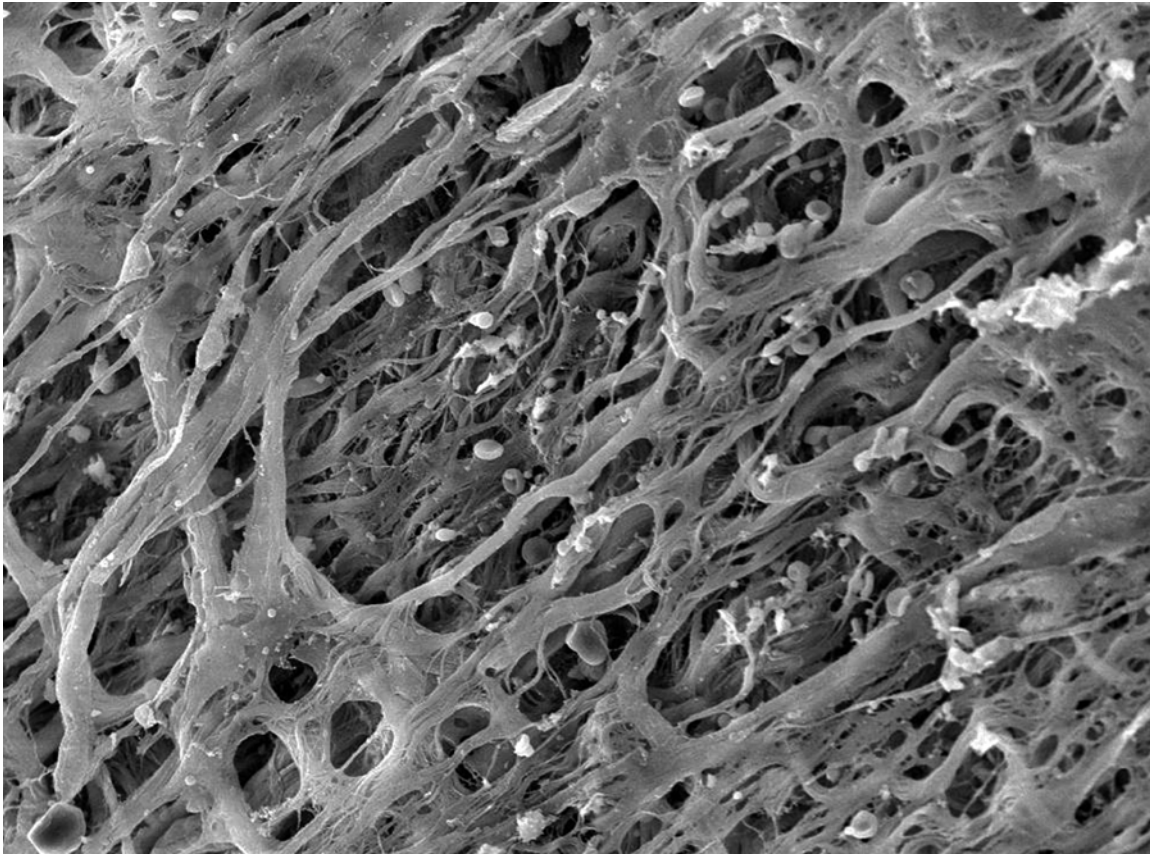


Fig. 21.13 Spinal arachnoid layer. Internal surface of arachnoid layer. Scanning electron microscopy. Magnification $\times 500$

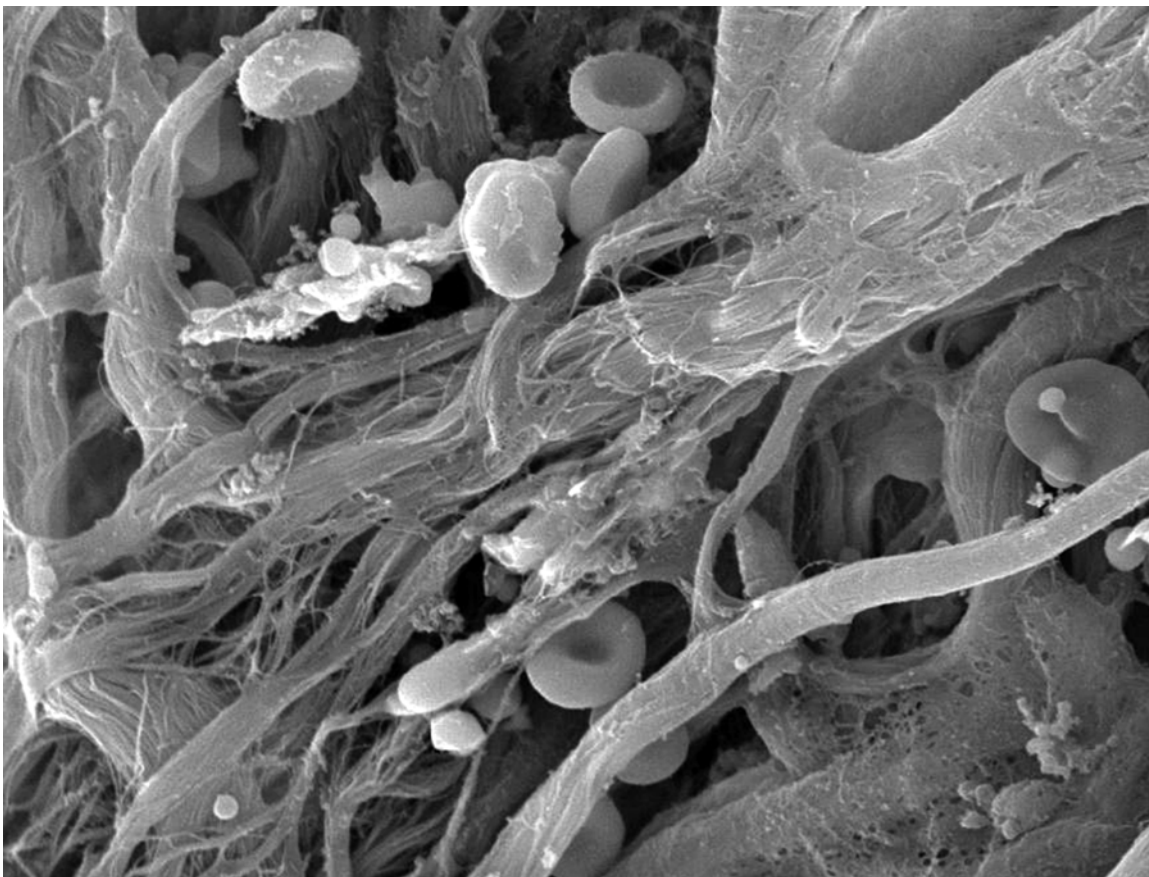


Fig. 21.14 Spinal arachnoid layer. Internal surface of arachnoid layer. Scanning electron microscopy. Magnification $\times 2,000$

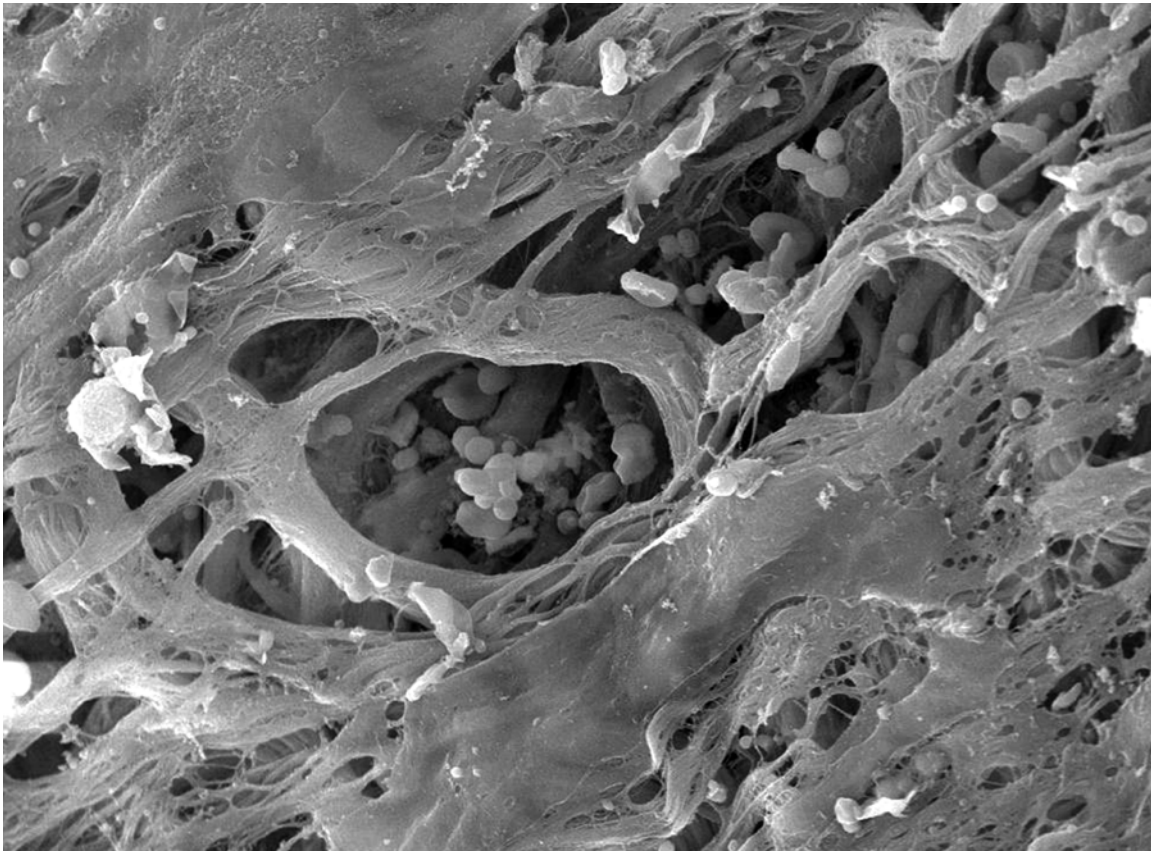


Fig. 21.15 Spinal arachnoid layer. Internal surface of arachnoid layer. Scanning electron microscopy. Magnification $\times 1,000$

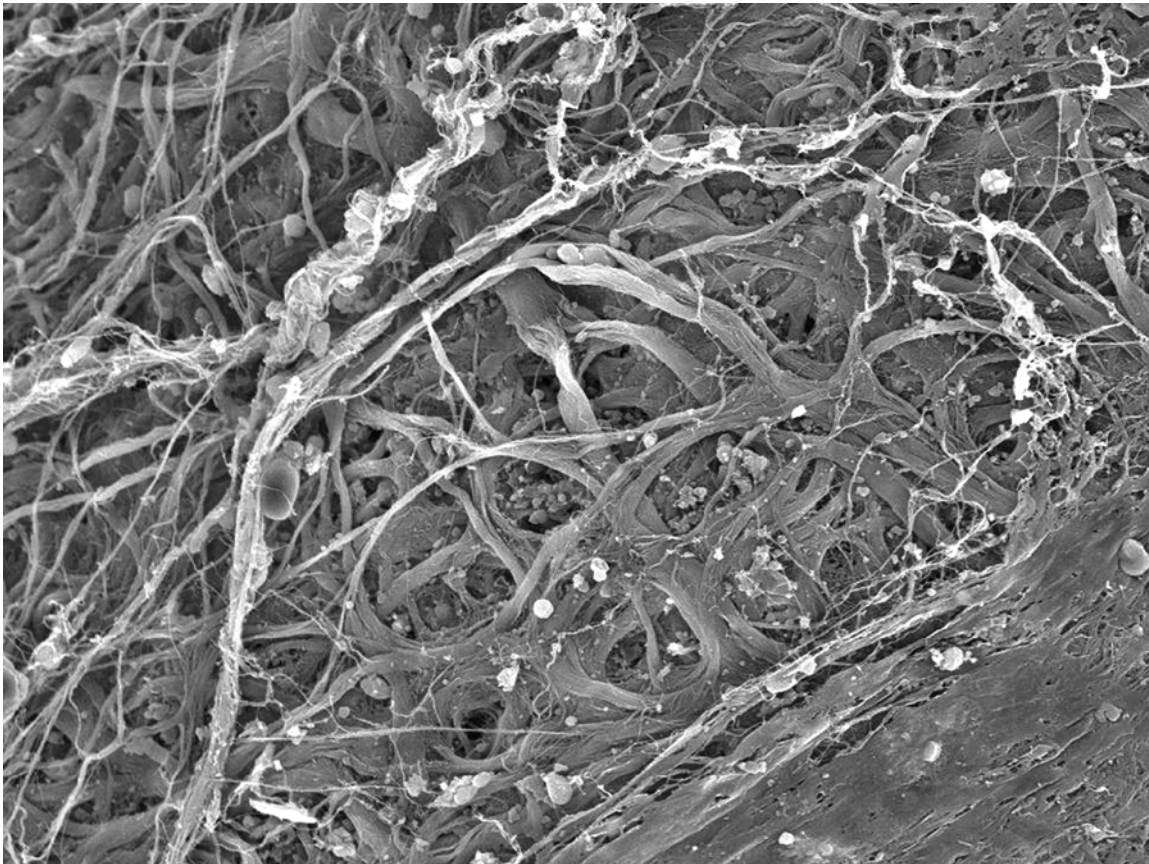


Fig. 21.16 Spinal arachnoid layer. Internal surface of arachnoid layer. Scanning electron microscopy. Magnification $\times 500$

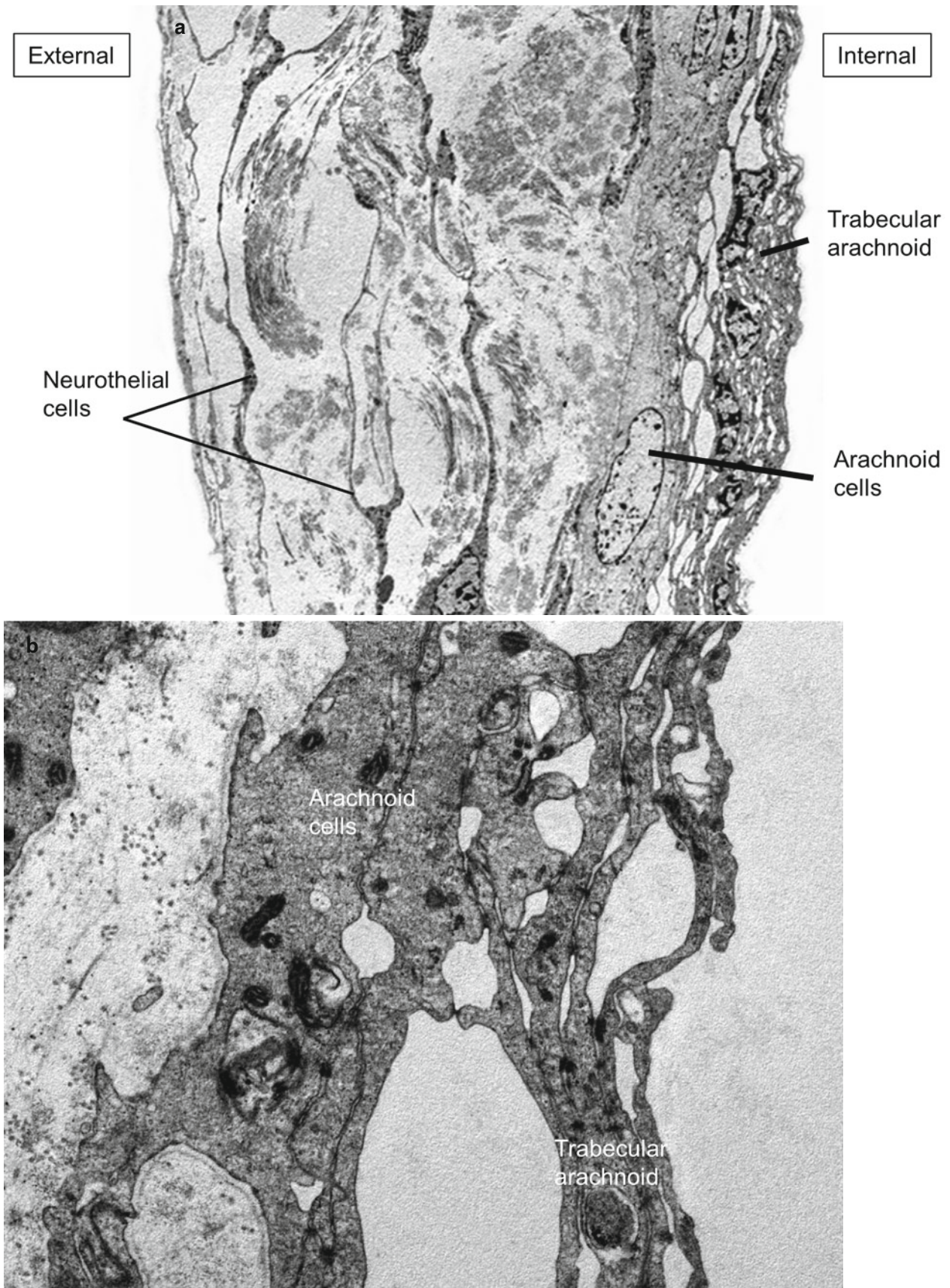


Fig. 21.17 Spinal arachnoid layer. (a), Total thickness of the spinal arachnoid layer (magnification $\times 3,000$). (b) Detail of (a) (magnification $\times 25,000$). Transmission electron microscopy

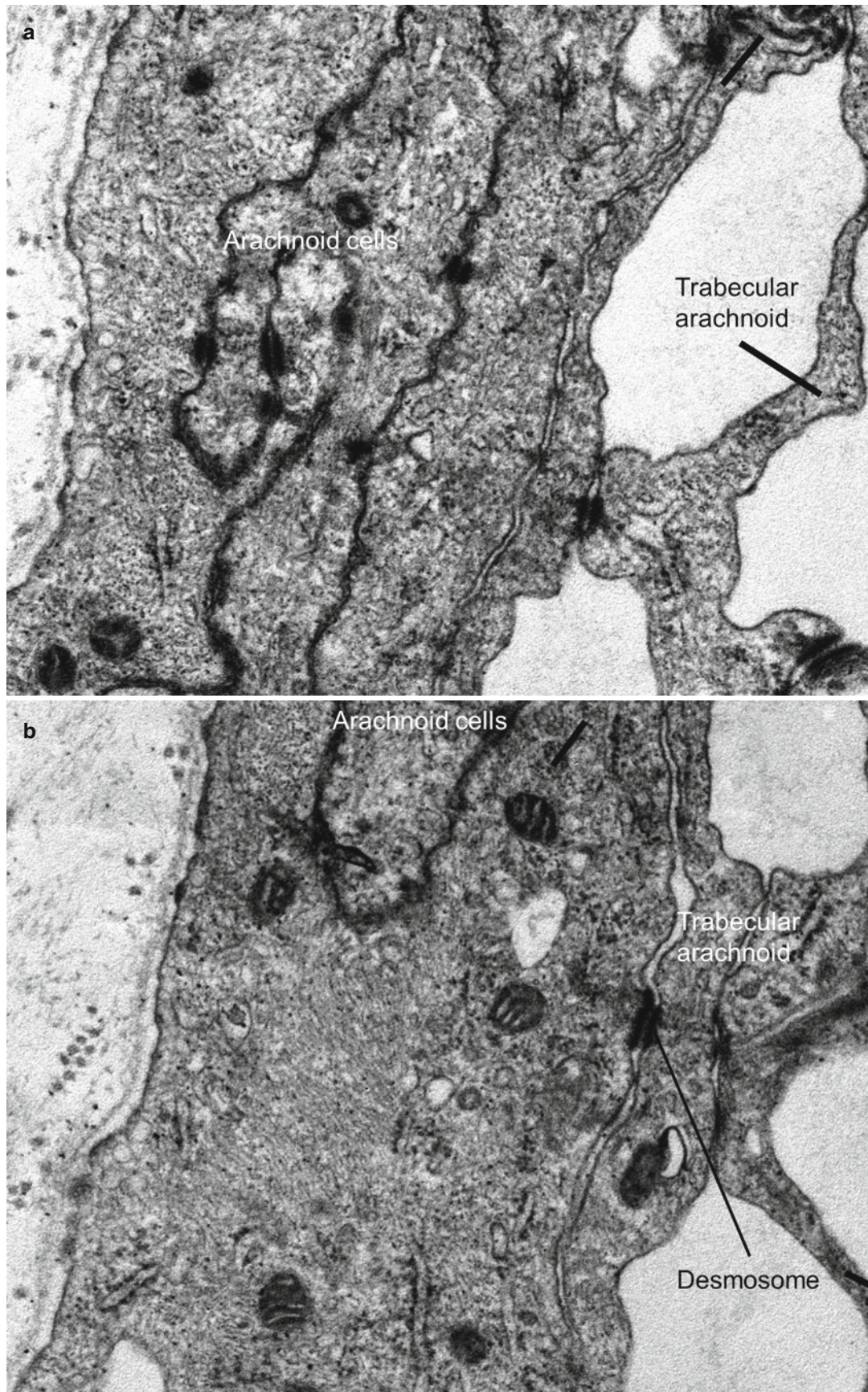


Fig. 21.18 Spinal arachnoid layer, partial thickness. Detail of arachnoid cells and specialized membrane junctions. Transmission electron microscopy. **a** and **b**, Magnification $\times 50,000$

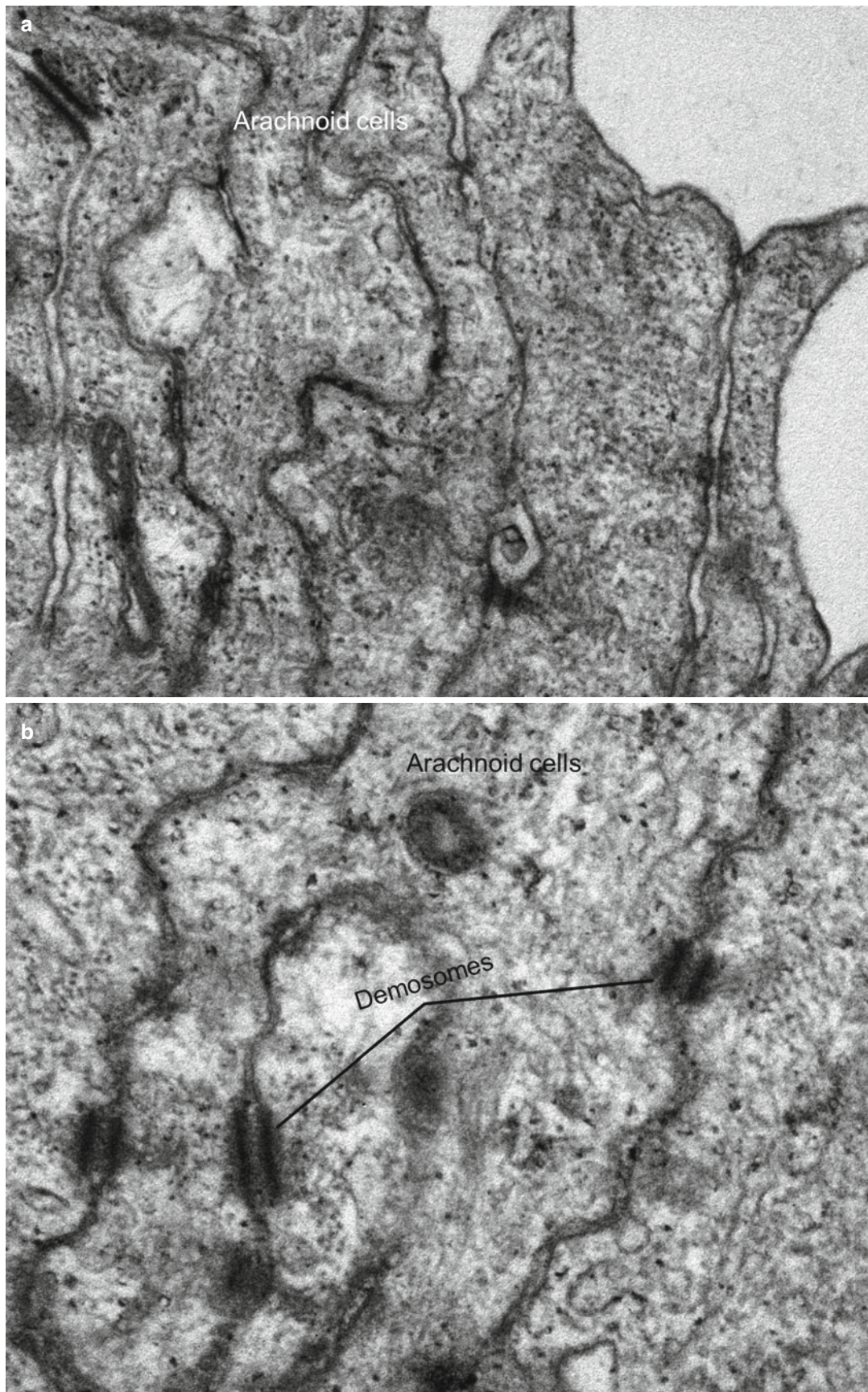


Fig. 21.19 Spinal arachnoid layer, partial thickness. Detail of arachnoid cells and specialized membrane junctions. Transmission electron microscopy. Magnification: **a**, $\times 80,000$; **b**, $\times 120,000$

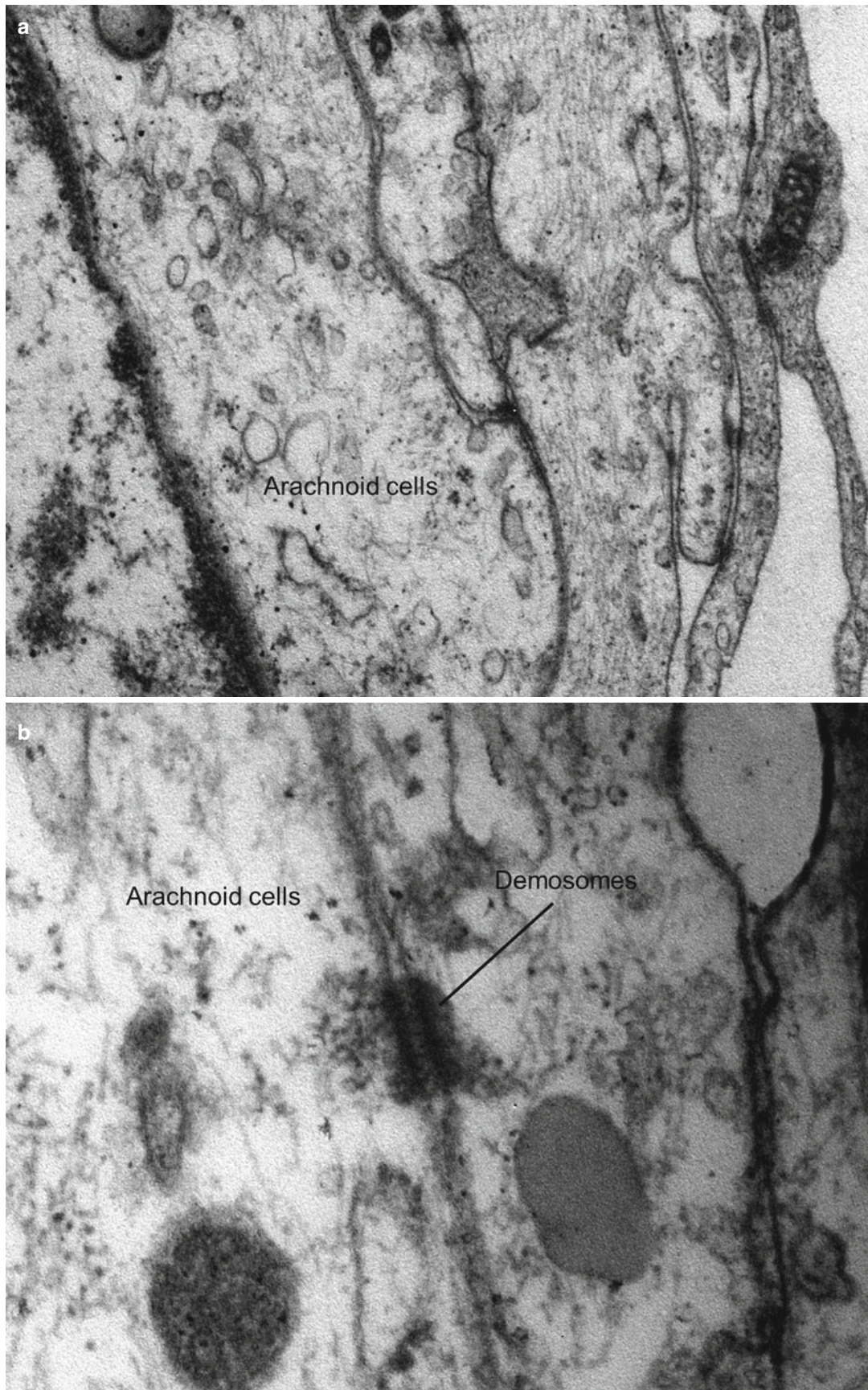


Fig. 21.20 Spinal arachnoid layer, partial thickness. Detail of arachnoid cells and specialized membrane junctions. Transmission electron microscopy. Magnification: **a**, $\times 50,000$; **b**, $\times 150,000$ (**b** from Reina et al. [6]; with permission)

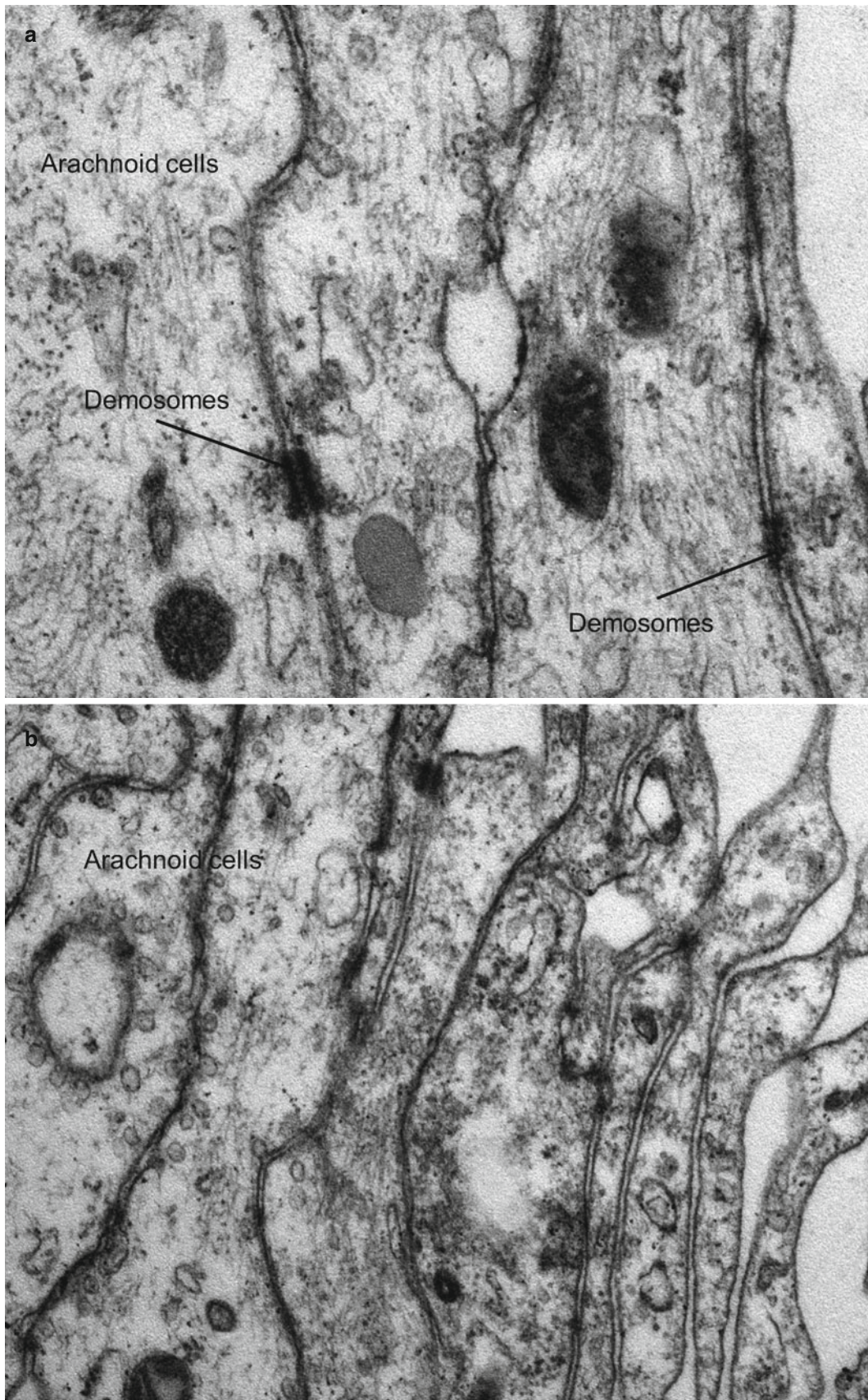


Fig. 21.21 Spinal arachnoid layer, partial thickness. Detail of arachnoid cells and specialized membrane junctions. Transmission electron microscopy. Magnification: **a**, $\times 80,000$; **b**, $\times 50,000$ (**a** from De Andrés et al. [3]; with permission)

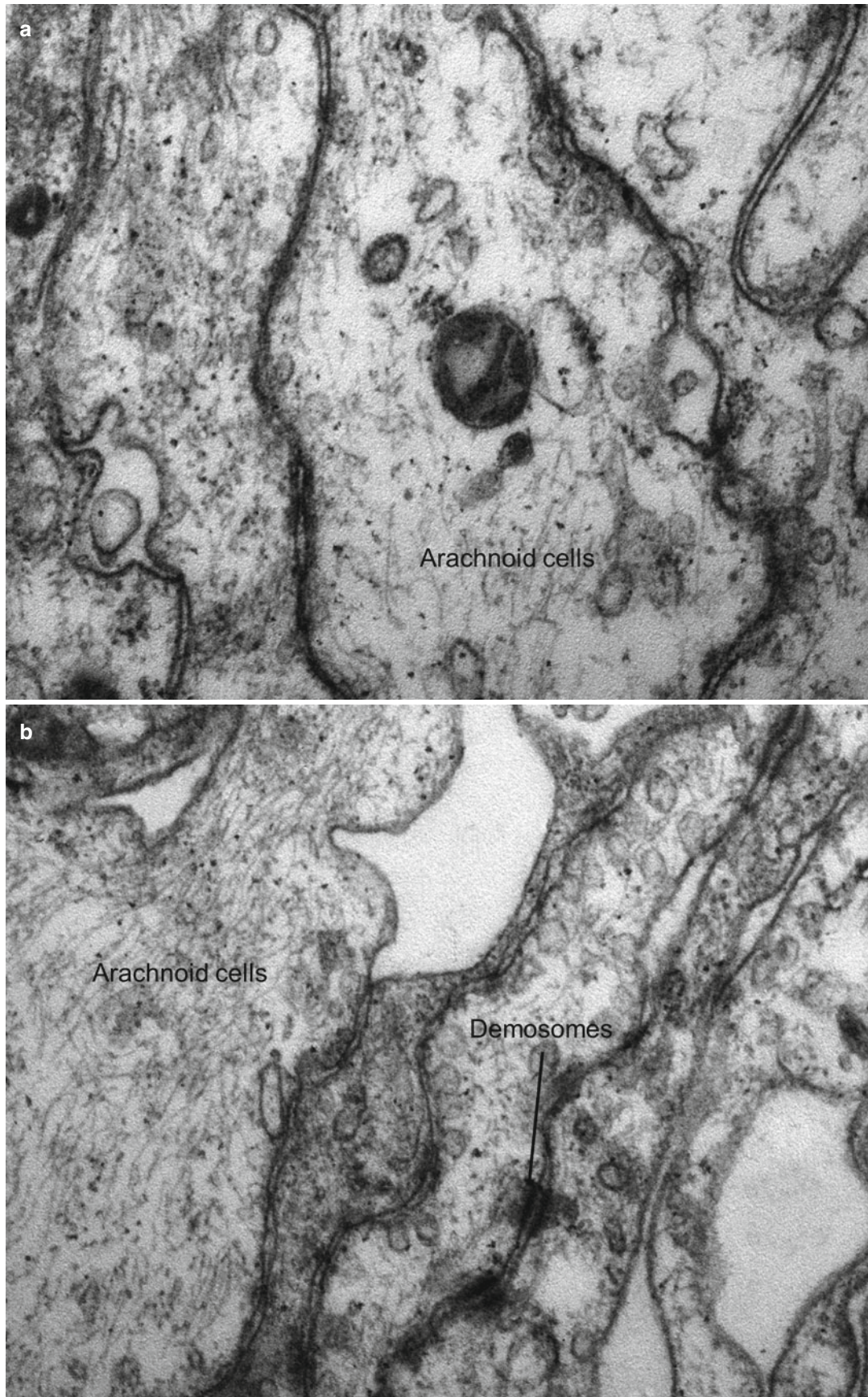


Fig. 21.22 Spinal arachnoid layer, partial thickness. Detail of arachnoid cells and specialized membrane junctions. Transmission electron microscopy. **a** and **b**, Magnification $\times 80,000$

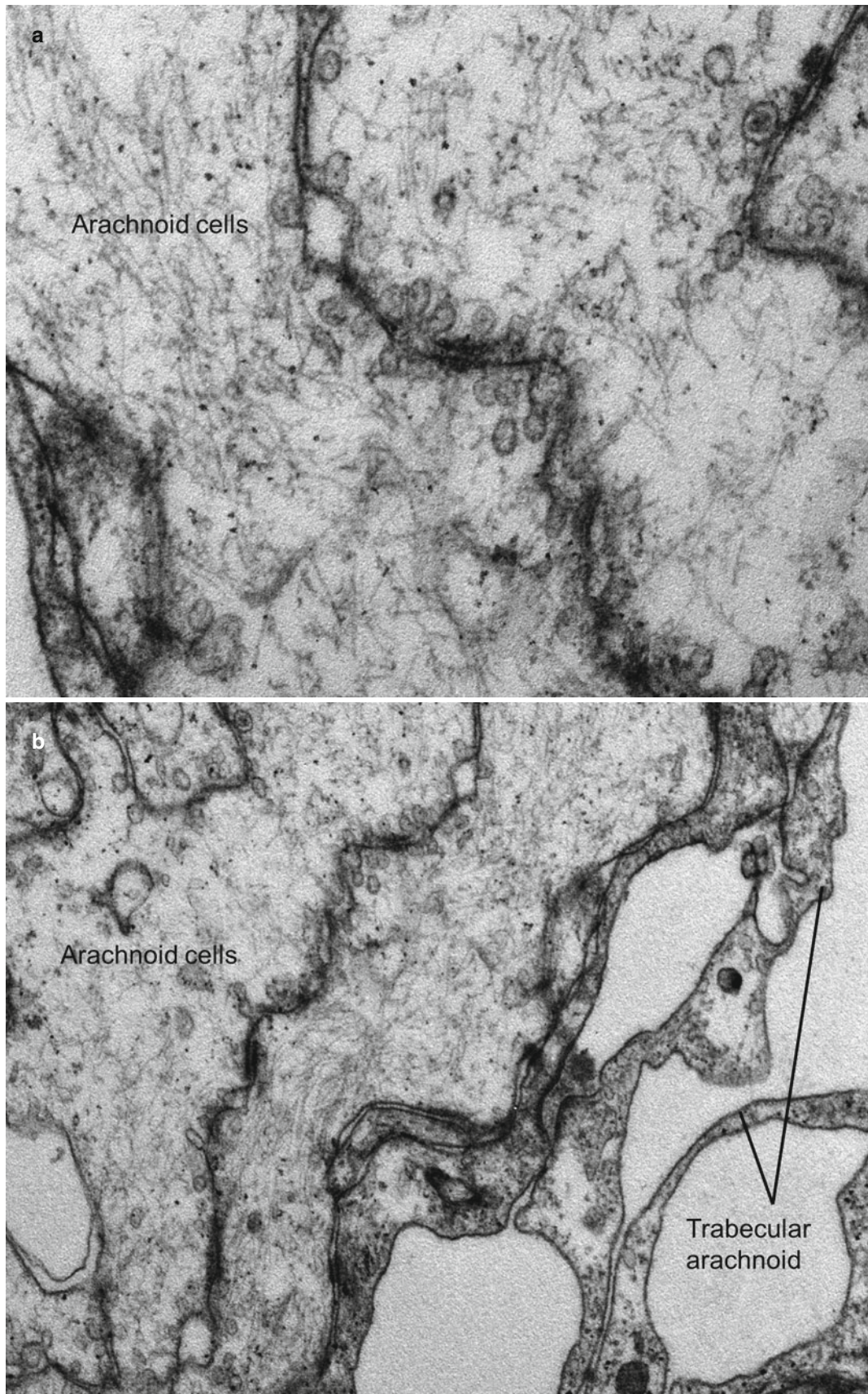


Fig. 21.23 Spinal arachnoid layer, partial thickness. Detail of arachnoid cells and specialized membrane junctions. Transmission electron microscopy. Magnification: **a**, $\times 80,000$; **b**, $\times 40,000$

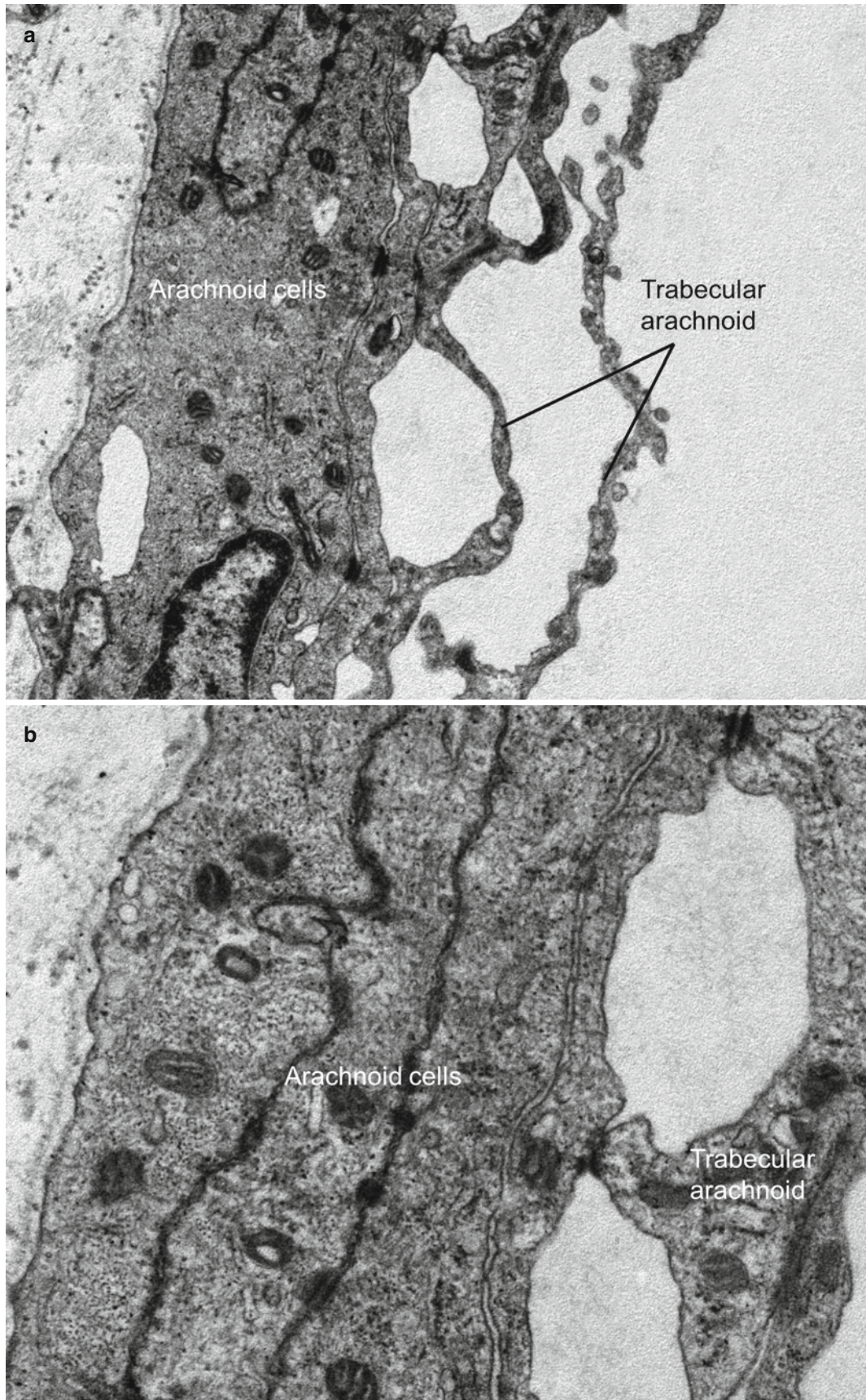


Fig. 21.24 Spinal arachnoid layer, partial thickness. Detail of arachnoid cells and specialized membrane junctions. Transmission electron microscopy. Magnification: a, $\times 25,000$; b, $\times 50,000$

References

1. Reina MA, Prats-Galino A, Sola RG, Puigdellívol-Sánchez A, Arriazu Navarro R, De Andrés JA. Structure of the arachnoid layer of the human spinal meninges: a barrier that regulates dural sac permeability. *Rev Esp Anesthesiol Reanim.* 2010;57:486–92.
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