

3D Meniscus Atlas

HIGH-YIELD

- Menisci cover one-half to two-thirds of the tibial articular surface and transmit 40%–60% of load in stance.
- Lateral meniscus bears ~70% of lateral compartment load; medial meniscus bears roughly half of medial load.
- Circumferential fibers generate hoop stress; a complete radial tear or root avulsion abolishes it, equalling meniscectomy.
- Vascular supply reaches only 10%–30% of medial and 10%–25% of lateral meniscal width from the periphery.
- Ideal repair: unstable longitudinal tear >1 cm in the red zone; combined with ACL reconstruction, ~90% healing.
- Bucket-handle: inner fragment in the notch causes true locking; operative treatment is mandatory.
- Root tear: extrusion >3 mm indicates meniscectomy-equivalent load; transtibial pull-out repair is preferred.
- Ramp lesion: missed on preoperative MRI in >50% of cases; ACL reconstruction alone is insufficient.
- Medial total meniscectomy: contact area down 50%–70%, stress up 100%; lateral: stress up 200%–300%.
- Resecting one-third of meniscal volume can raise contact forces by up to 350%.

PITFALLS

- Incomplete radial tear preserves hoop stress; only extension to the capsular margin or root avulsion equals meniscectomy.
- MRI misses root tears in up to 70% of cases; clinical suspicion and arthroscopic probing are mandatory.
- Degenerative MRI signal in patients over 40 is not an automatic indication for arthroscopic debridement.

FURTHER READING

Campbell's Operative Orthopaedics, 15th edition (2026): Knee Injuries, ch 50 (menisci: anatomy, function, tears, repair and meniscectomy).
Campbell's Operative Orthopaedics, 15th edition (2026): ch 56 (arthroscopy of the knee).

NUMBERS TO KNOW

Plateau coverage by menisci	one-half to two-thirds
Load transmitted in stance	40%–60%
Lateral compartment load borne by lateral meniscus	~70%
Vascular penetration, medial meniscus	10%–30% of width
Vascular penetration, lateral meniscus	10%–25% of width
Minimum tear length for repair	>1 cm
Extrusion threshold for root tear significance	>3 mm
Contact stress increase after lateral total meniscectomy	200%–300%

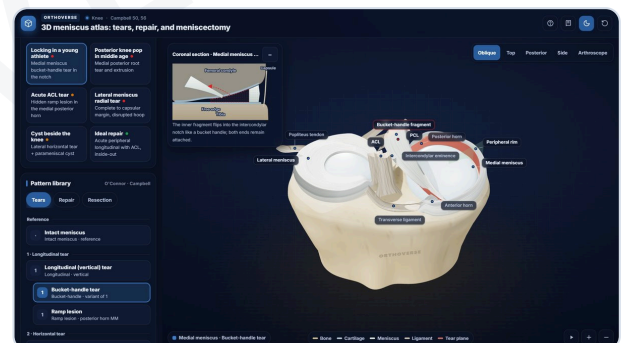


Figure. Locking in a young athlete: a medial bucket-handle fragment displaces into the notch.