Anatomy of the Ocular Fundus

Devin D. Mackay, M.D.
Valérie Bioussé, M.D.
Anatomy of the Ocular Fundus

Figure 1
Anatomy of the Ocular Fundus

Superior vascular arcade

Inferior vascular arcade

Macula

Fovea

Macula

Temporal retina

Nasal retina

Right eye

Figure 2
Anatomy of the Optic Disc

Cilioretinal artery
Optic cup
Peripapillary retina
Optic disc
Cup-to-disc ratio: 0.4

Figure 3
Normal Optic Disc

• The lamina cribrosa is a fenestrated, mesh-like formation of collagen at the optic nerve head through which ganglion cell axons pass to form optic nerve (Figure 4A), and is sometimes visible within the optic cup.

• The normal optic disc is slightly more pale temporally than nasally (Figure 4B).
  – More ganglion cell axons enter the optic disc nasally than temporally, making the temporal portion of the optic disc slightly more pallid.
Anatomy of the Optic Disc

Figure 4

A: Fenestrations of lamina cribrosa visible within optic cup

B: Normal optic disc color

Nasal

Temporal
Anatomy of the Optic Disc

• A scleral crescent is a normal finding and may be found when a tilted optic nerve inserts into the globe at an oblique angle. The retina does not meet the edge of the optic disc in this case, displaying a crescent of underlying sclera (Figure 5).

Figure 5
Cup-to-Disc Ratio

• Cup-to-disc ratio is the ratio of the diameter of the optic cup to the diameter of the optic disc (Figure 6)
  – Normal ratios are variable
  – An increased cup-to-disc ratio may be referred to as “cupping” and may be seen in:
    • Normal optic nerves (physiologic cupping)
    • Glaucoma
    • Compressive optic neuropathy
    • Hereditary optic neuropathy
    • Congenital anomalies
Cup-to-Disc Ratio

Figure 6

A

B

c/d ratio 0.0 (cupless)

C

c/d ratio 0.4

D

E

c/d ratio 0.5

F

G

c/d ratio 0.7

H

Figure 6
Red-Free Fundus Photography

- A green filter is used to remove red colors, creating a “red-free” image
  - Enhances contrast of vessels and the retinal nerve fiber layer
    - Useful in the detection of small retinal hemorrhages, microaneurysms, and hard exudates
    - The retinal nerve fiber layer superior and inferior arcuate bundles appear slightly whitened in comparison with the background retina (Figure 6)
Figure 7. Red-free photograph highlighting the retinal nerve fiber layer in white
Fluorescein Angiography

- Intravenous contrast dye is used to image the retinal and choroidal circulation
  - Fundus photographs are performed as contrast dye passes through:
    1. The short posterior ciliary arteries to fill the optic disc and choroid, followed by
    2. The retinal arterial circulation, followed by
    3. The retinal veins, filling in a laminar pattern (Figure 7B)
    4. Minutes later, fluorescein is no longer seen in retinal vessels, but stains several structures, including the optic nerve head (Figure 8B)
- The macular capillary-free zone is seen as dark because choroidal fluorescence is blocked by xanthophyll pigment and closely-spaced retinal pigment epithelial cells in this region (Figure 8A)
Fluorescein Angiography

A

Arteries filled with contrast
Background contrast from choroidal vessel filling

B

Retinal vein
Retinal artery
Laminar flow through retinal vein

Figure 8
Fluorescein Angiography

Figure 9

A

B

Normal late optic disc staining

Macula capillary-free zone