Penn Veterinary Medicine

Normal Fundus and Variations

in the

Dog, Cat and Horse

University of Pennsylvania
School of Veterinary Medicine
Ophthalmology
©2006

James V. Schoster, DVM DACVO

Many Species. One Medicine. ™

Normal Fundus and Variations

Key Points of Understanding

- Normal Ocular Anatomy
- Ophthalmoscopy
- Ophthalmoscopic Ocular Anatomy

Penn Veterinary Medicine

Normal Ocular Anatomy

"As a diagnostician one should have an appreciation of the anatomy of the eye. Not for it's academic worth, but for the clinical aspect of Ophthalmoscopy"

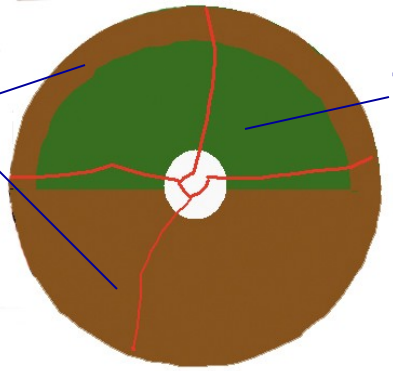
Milton Wyman, DVM MS DACVO

Penn Veterinary Medicine

Normal Ocular Anatomy

The Fundus is typically divided into the tapetal and nontapetal fundus area. The tapetal area is in the superior half of the fundus and the nontapetal area is in the inferior half of the fundus as well as the periphery of the superior fundus.

The Optic disc is typically centrally located but will vary in its location depending on the species*.



Dog Fundus

Optic Disc Locations* (species variance)

-Dog: at tapetal-nontaptetal junction

-Cat: tapetal area

-Horse: nontapetal area

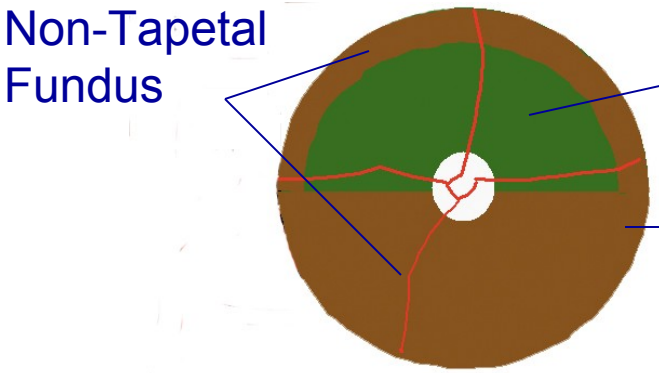
Penn Veterinary Medicine

Normal Ocular Anatomy

The Retinal Vascular Patterns vary with the species.

Dogs and cats have retinal blood vessels that traverse over the entire fundus. In the horse the blood vessels only emanate a short distance from the optic disc.

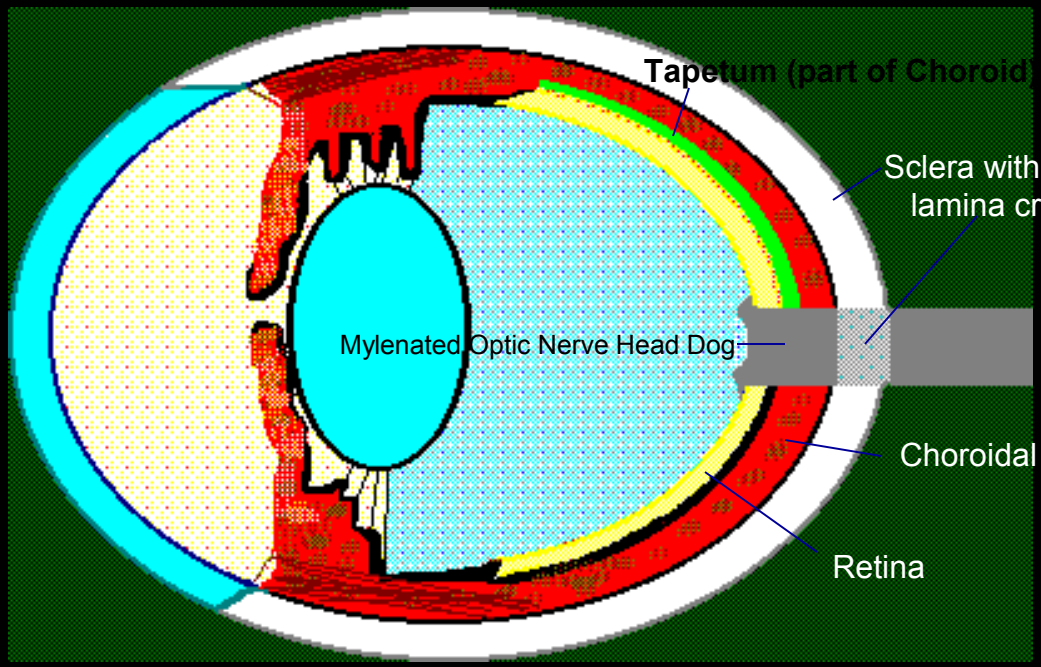
In the dog and cat a distinct difference can be seen between the cilioretinal arteries and veins with the veins being larger in diameter and arranged typically as a superior, nasal and temporal and occasional inferior arcade.





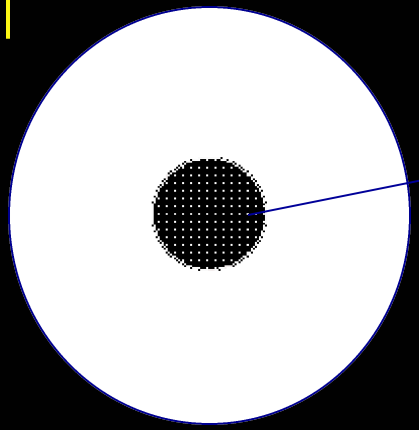
Penn Veterinary Medicine

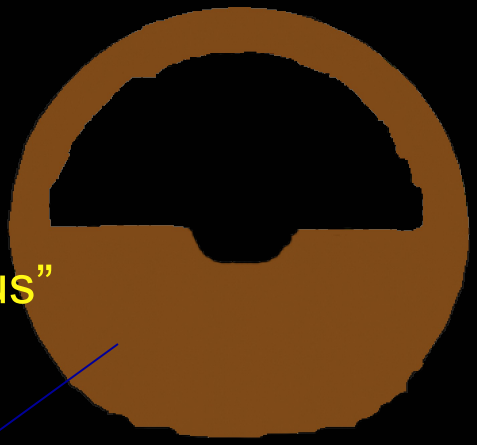
Normal Ocular Anatomy



Penn Veterinary Medicine

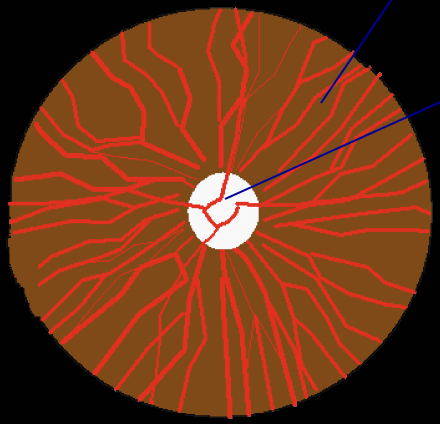
Normal Ocular Anatomy

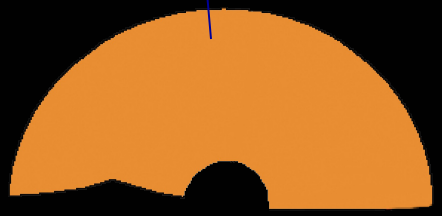


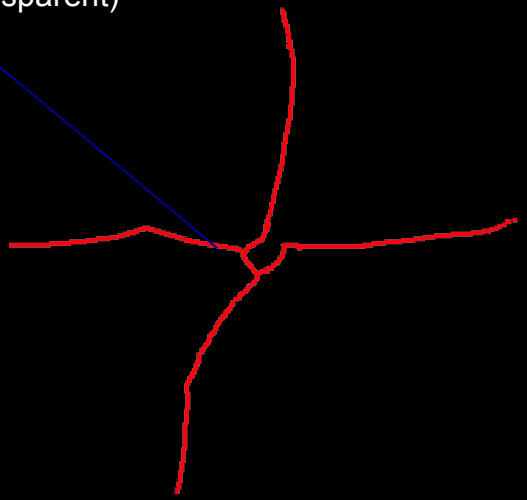


Separated Layers of the "Fundus"

1. Sclera with lamina cribosa
2. Choroidal vessels with pigment
3. Tapetum (part of Choroid)
4. Retina
   a. Retinal Pigmented Epithelium central area has no pigment to allow tapetum to show through
   b. Other 9 layers of retina (transparent) except for blood vessels.
5. Mylenated Optic Nerve Head







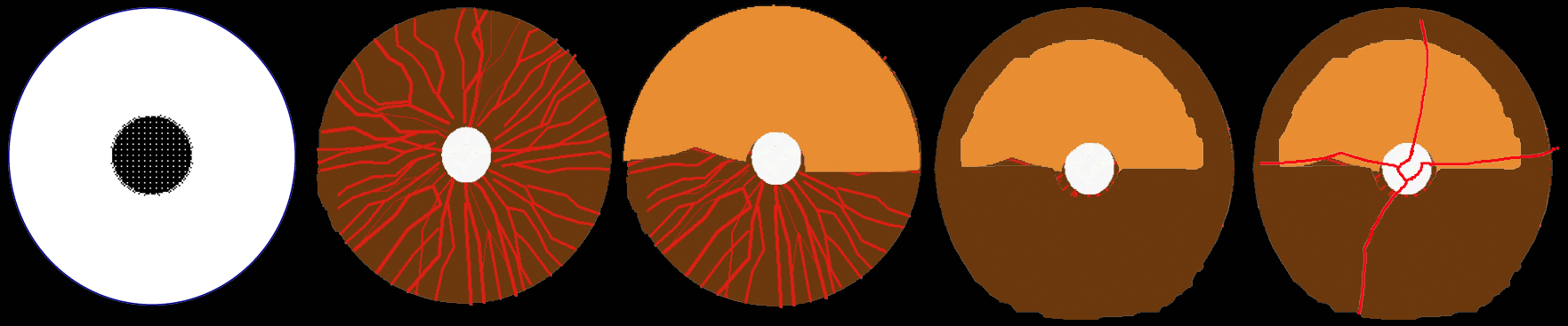
This slide shows the "coats" of the back of the eye separated from each other

Penn Veterinary Medicine

This series of drawings shows how the different layers of the globe mask each other as they are laid down and how this masking affects the final ophthalmoscopic appearance of the fundus.

Normal Ocular Anatomy

Final Appearance of Fundus



Sclera with lamina cribosa + Choroidal vessels with pigment + Tapetum (part of Choroid) + *Retinal Pigmented Epithelium + Other 9 layers of retina including Blood Vessels

*(no pigment in cells over Tapetum, results in transparent zone over Tapetum)

The drawings above represent the different layers of the inside of the back of the eye as viewed through the ophthalmoscope. Starting at the far left and working to the right, each successive drawing is to represent the summation of each additional layer as it is “laid down” and the resulting appearance of the fundus due to “masking” of the layer just below depending if the layer above is transparent or not.
Please look at the previous page to see how each layer appears individually with regard to portions of the layer being transparent or not.

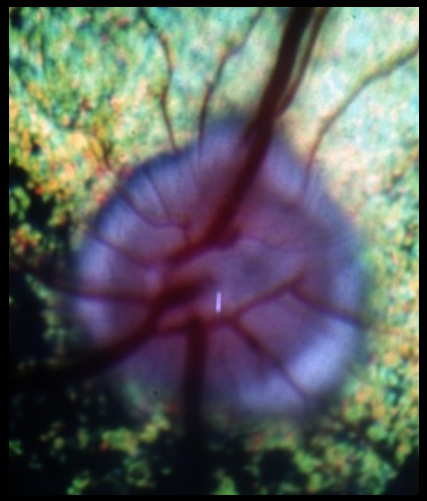
Penn Veterinary Medicine

Optic Disc Variations

The normal Optic Disc varies in shape, color and position within and across species.

On the next slide are a few examples of some normal variations due to excessive myelination in the dog and in the cat a pigmented ring circumscribing the optic disc.

Optic Disc Variations



Dog



Dog



Dog



Cat

Ophthalmoscopy

- Indirect Ophthalmoscopy
  - Monocular or binocular
    - Wider field of view than direct
    - Examiner's face is a safe distance from patient
    - Binocular method allows for 3 dimensional image
    - Monocular method is great for quick clinical survey of fundus

Monocular



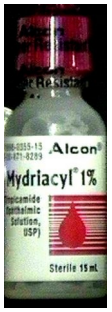
Binocular



Hand Lens



- Direct Ophthalmoscopy
  - Small field of view but high magnification
  - Panoptic Head gives larger field of view than Direct
  - Examiners face is very close to patient's face
  - Direct Head  or Panoptic Head 
- Mydriasis
  - Artificial dilation of pupil necessary for full view of fundus



- Anticholenergic drops - Use short acting only NOT **ATROPINE**
  - Tropicamide 1% (Mydriacyl®) = drug of choice (lasts 4 - 6 hours)
- **Caution!** Dilation of the pupil can cause harm. Conditions such as glaucoma, uveitis, dry eye could be worsened or result in additional serious complications by the use of these drugs. A complete ocular examination must always precede the use of mydriatics. The pre-dilation examination must include measurement of intraocular pressure.

Penn Veterinary Medicine

Ophthalmoscopy

- Indirect Ophthalmoscopy
  - the view is upside-down and backwards, less magnified with a larger field of view.





- Direct Ophthalmoscopy
  - The view is upright and more magnified with a smaller field of view.

Penn Veterinary Medicine

Ophthalmoscopy

- Monocular Indirect

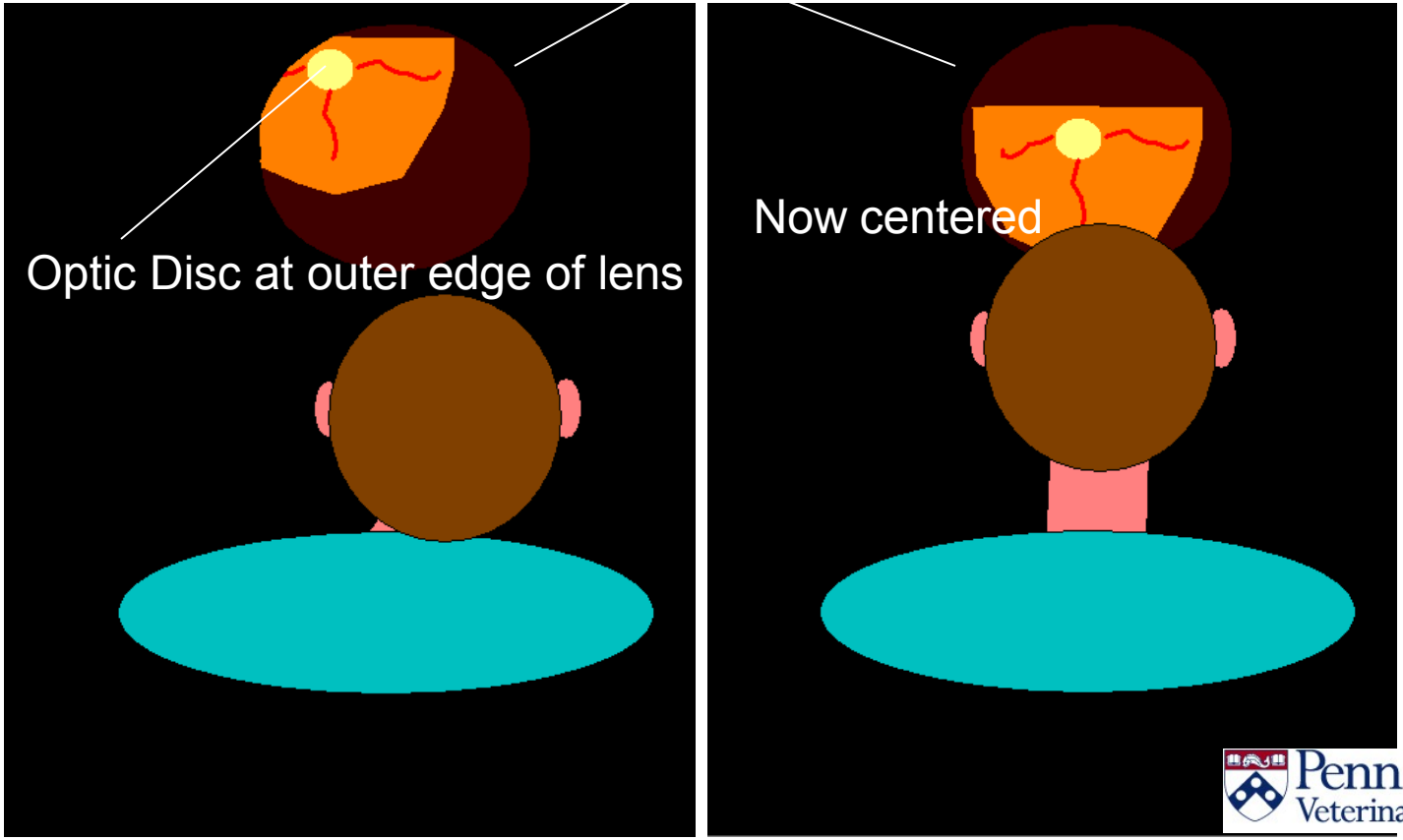


Provides a wider field of view of the fundus than direct ophthalmoscope.
Examiner's face is not close to patient
Image is upside down and backwards as viewed in lens

Penn Veterinary Medicine

Ophthalmoscopy

- Indirect Tip
  - To bring the image of what you want to see to the center of your hand lens just move your head in the direction of the object you want to see centered. **HAND HELD LENS**

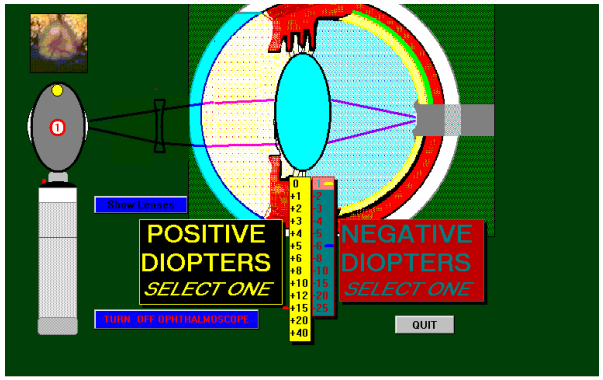


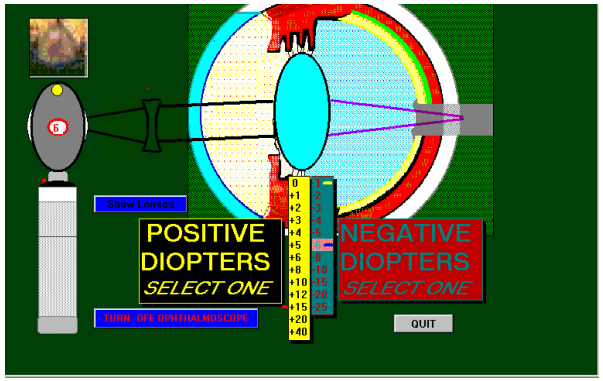
Penn Veterinary Medicine

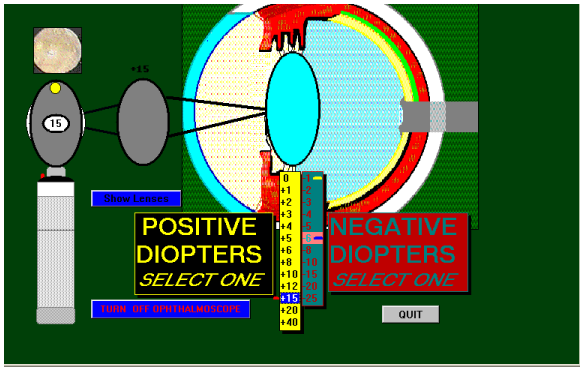
Ophthalmoscopy

- Direct Ophthalmoscope Tips

(when holding the scope at your brow and very close to the patient's eye (1 - 2 CM)







0 to -1 diopters
Focus on fundus for most examiners.
Keep both eyes open and Look as though you are looking past the patient to block your own accommodation.

More negative diopters
Focuses more posterior

More positive diopters
Focuses more anterior

Penn Veterinary Medicine



Normal CANINE Fundus

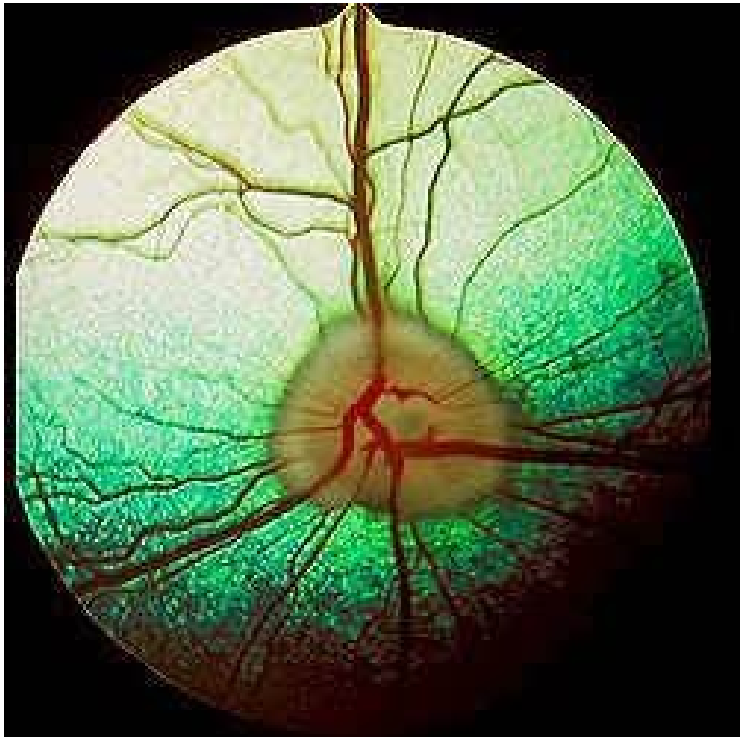


Penn Veterinary Medicine

Dog

Normal Canine Fundus

- The tapetal zone is superior/central and the non-tapetal zone is inferior and peripheral
- The vascular pattern consists of usually 3 - 4 retinal veins that emerge from the central area of the optic disc at a C shaped venous anastomosis and traverse over the entire fundus. There are several more smaller cilioretinal arteries that have a similar pattern but are smaller.
- The optic disc is always located at the tapetal / non-tapetal junction and is somewhat triangular to round, pale pink to white in color due to myelination. There is a small central depression (physiological cup or depression) where the previous hyaloid vessel had emerged.
- The adult tapetum varies in color variations from yellow, green and orange.
- The non-tapetal color is a variation of brown to reddish brown color when pigment is present.
- The tapetal - nontapetal junction varies from a sharp border to ragged in relation to the hair coat length (short haired = sharp and long haired = ragged).



Penn Veterinary Medicine

Dog



Penn Veterinary Medicine

Normal Immature Fundus



The tapetum is still developing after birth and does not mature until about 4 months of age. Prior to that time the tapetal area appears tan to slate to blue in color. As the tapetum matures, its adult color develops.

Penn Veterinary Medicine

Tapetal Variations



1. Color Variations
   The adult tapetum varies in color variations from yellow, green and orange.
- Junctional Variations
  The tapetal - nontapetal junction varies from a sharp border to ragged in relation to the hair coat length (short haired = sharp and long haired = ragged).
- Pattern Variations
  Lack of tapetum
  Lack of pigment in retinal pigmented epithelium
  Lack of Choroidal Pigment

Penn Veterinary Medicine

Normal Ocular Anatomy

Atapetal Fundus



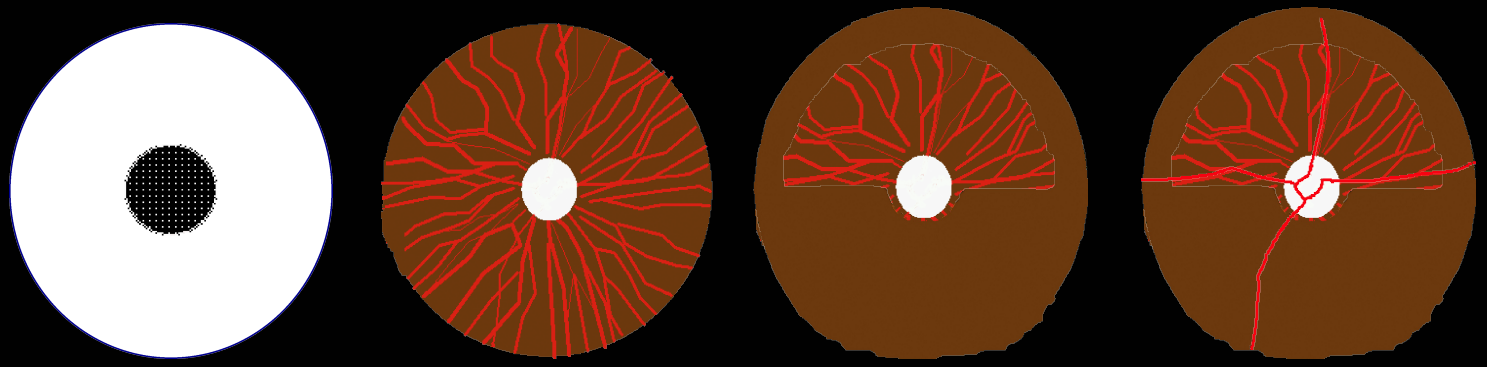


Penn Veterinary Medicine

Normal Ocular Anatomy

Atapetal Fundus

Final Appearance of Fundus



Sclera with lamina cribosa + Choroidal vessels with pigment and **No Tapetum** + *Retinal Pigmented Epithelium + Other 9 layers of retina including Blood Vessels

*(no pigment in cells over Tapetum, results in transparent zone over Tapetum)

The drawings above represent the different layers of the inside of the back of the eye as viewed through the ophthalmoscope. Starting at the far left and working to the right, each successive drawing is to represent the summation of each additional layer as it is "laid down" and the resulting appearance of the fundus due to "masking" of the layer just below depending if the layer above is transparent or not.

An atapetal fundus is a normal variation that is seen more often in color dilute animals and or with blue irides. Since the tapetal layer is in the region of the choroid closest to the retina, when the tapetum is absent, the result will be "unmasking" or visualization of the choroidal vessels in the tapetal zone during the ophthalmic examination. See "Final Appearance" drawing above.

Penn Veterinary Medicine

Normal Ocular Anatomy

A variation of normal = no pigment in entire RPE and tapetum present

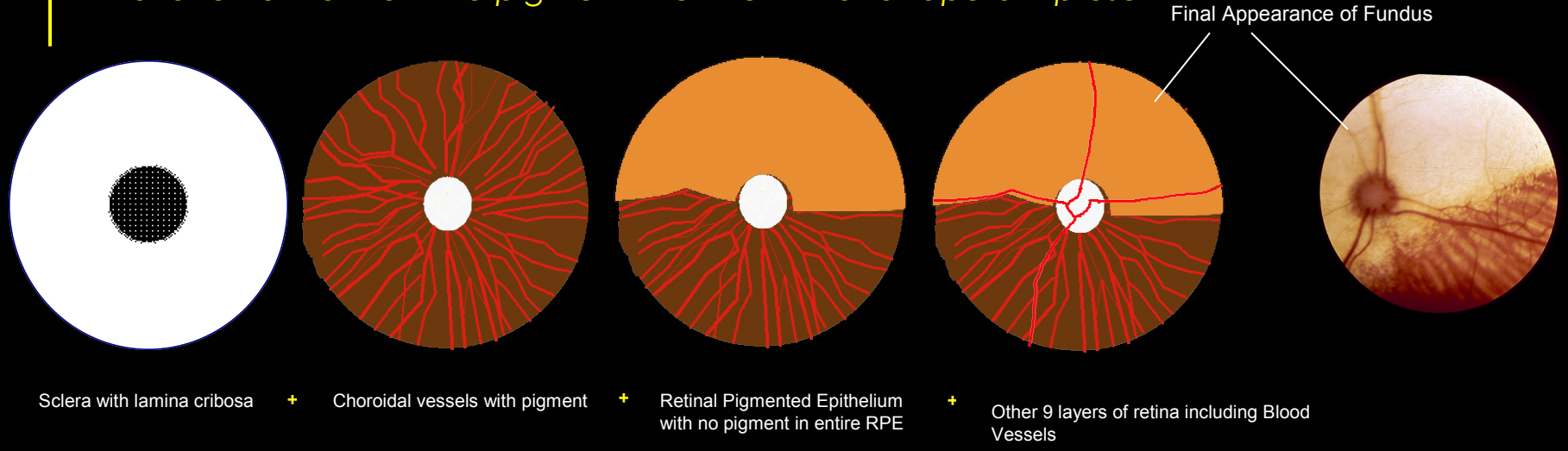


Feline

Penn Veterinary Medicine

Normal Ocular Anatomy

A variation of normal = no pigment in entire RPE and tapetum present



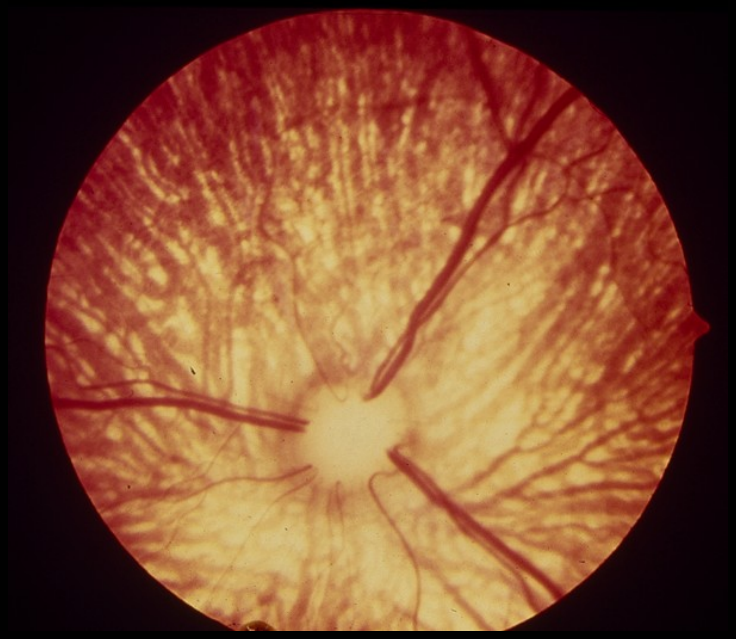
These drawings show why the normal variation of no pigment in the retinal pigmented epithelium in the non-tapetal zone will result in the appearance or SHOW of the choroidal vessels because the choroid is now UNMASKED due to the lack of RPE pigment.

This is a fairly common variation of normal in “color dilute” animals and certain breeds such as the Siberian Husky and Siamese Cat.

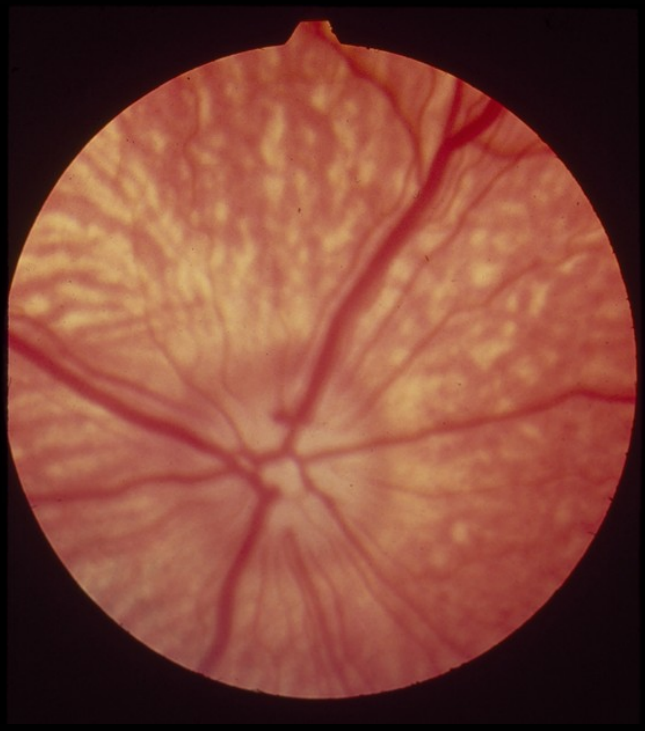
Penn Veterinary Medicine

Normal Ocular Anatomy

***Tigroid* (albinotic) Fundus (no tapetum/no RPE pigment with little to no pigment in the choroid as well)**



Feline

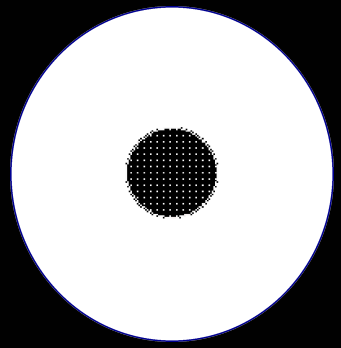


Canine

Penn Veterinary Medicine

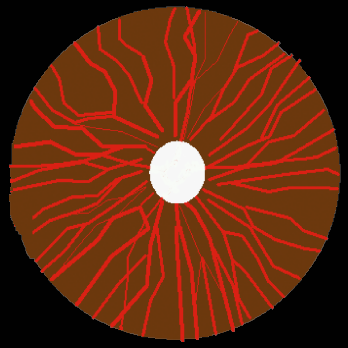
Normal Ocular Anatomy

Tigroid (albinotic) Fundus (no tapetum/no RPE pigment)



Sclera with lamina cribosa

+



Choroidal vessels with pigment and no tapetum with overlying Retinal Pigmented Epithelium that has no pigment resulting in a completely transparent RPE that does not mask the choroid and results in complete visibility of the choroidal vessels and interspersed pigment.

+



Other 9 layers of retina including Blood Vessels

These drawings show why the normal variation of no tapetum and no pigment in the retinal pigmented epithelium in the non-tapetal zone will result in the appearance or SHOW of all the choroidal vessels because the choroid is now completely UNMASKED due to the lack of a tapetum and RPE pigment.
The resulting "*Tigroid (albinotic) Fundus"* is a fairly common variation of normal in "color dilute" animals and especially with blue irides. The choroidal pigment will vary in amounts. The albinotic variation has little to no pigment in the choroid and thus appears almost like an albino would (see pictures on previous slide).

Penn Veterinary Medicine

Normal FELINE Fundus



Penn Veterinary Medicine

CAT

- Normal FELINE Fundus
  - The tapetal zone is superior/central and the non-tapetal zone is inferior and peripheral
  - The vascular pattern consists of usually 3 retinal veins that emerge from the edge of the optic disc and traverse over the entire fundus. There are several more smaller cilioretinal arteries that have a similar pattern but are smaller. The veins and arteries always emerge from the margin of the optic disc.
  - The optic disc is always located in the tapetal zone and is round, small and pale pink to white in color when observed under higher magnification with the direct ophthalmoscope and darker appearing when viewed with less magnification with the indirect scope. The optic disc itself appears slightly depressed because myelination only extends to the level of the lamina cribrosa so the physiological depression encompasses the majority of the disc. A pigmented ring often encircles the margin of the optic disc as well as a varying degree of "hyperreflective ring" or thinning of the retina encircling the disc as well as at times just a green or black ring about the disc.
  - The tapetum varies in color from yellow to yellow green
  - The tapetal color varies from blue-green to more yellow-red depending on coat color. Color dilute animals may lack part or all of the tapetum which results in showing of the choroidal vessels beneath.
  - The non-tapetal color is a variation of brown color.





Penn Veterinary Medicine

Cat

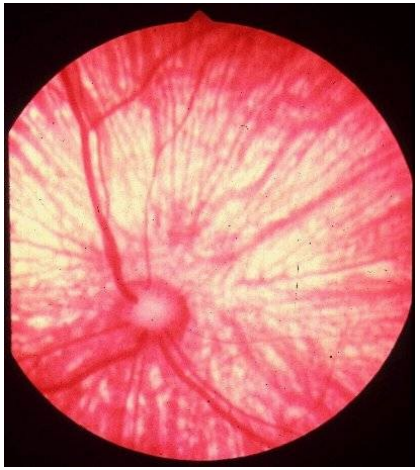
- Normal Feline Fundus
  - normal variations



Yellow Tapetal Color



Yellow Green Color

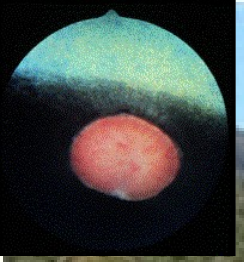


Tigroid Fundus



Lack of RPE pigment

Penn Veterinary Medicine

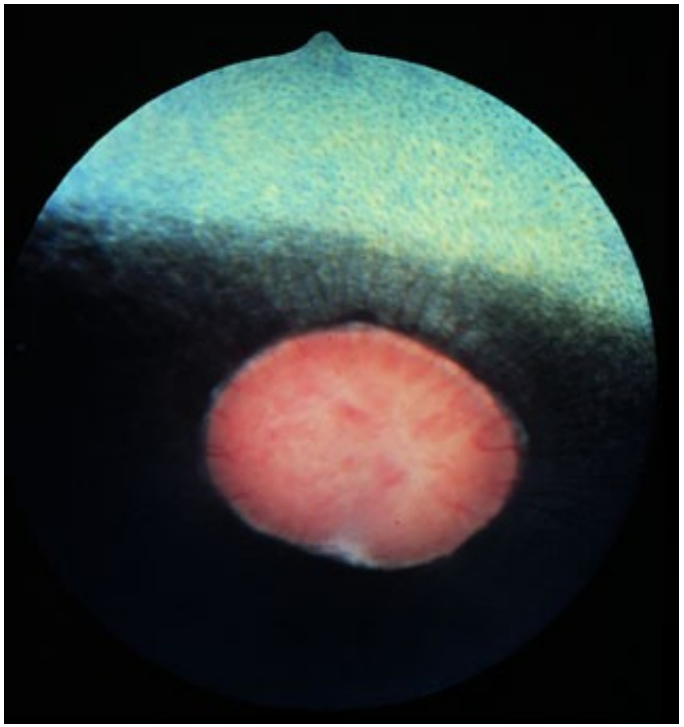


Normal EQUINE Fundus

Penn Veterinary Medicine

Horse

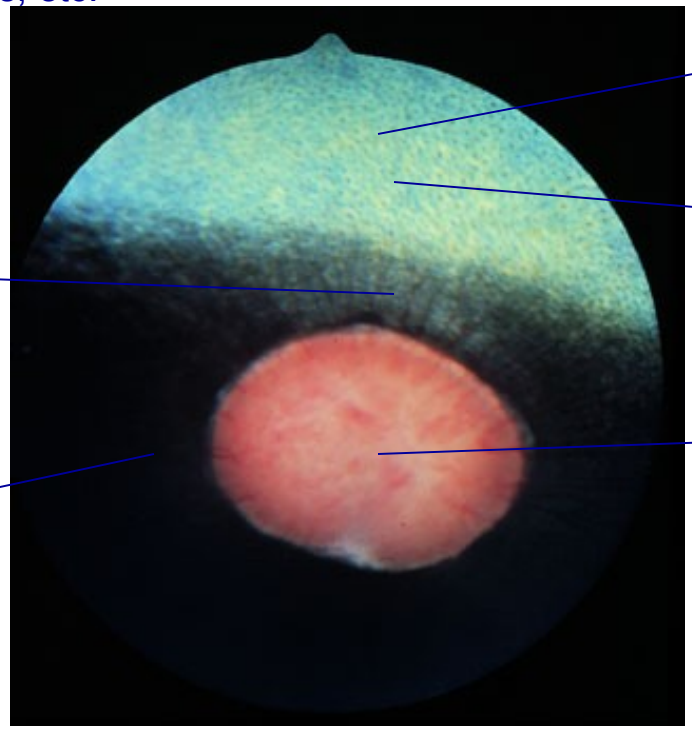
- Normal Equine Fundus
  - The tapetal zone is superior/central and the non-tapetal zone is inferior and peripheral
  - The vascular pattern consists of about 30 - 60 very small cilioretinal vessels that emerge from the edge of the optic disc 360 degrees and traverse only a short distance from the disc.
  - The pink optic disc is a mildly concave ellipse that is always in the the non-tapetal zone.
  - The tapetum has a granular or speckled appearance. The dark specks are called “Stars of Winslow” (stelullae of Winslow) and represent choroidal blood vessels communication of the deep choroidal vessels with choriocapillaris and the specks are the sites of tapetal penetration.
  - The tapetal color varies from yellow through green to bluish-purple with variations associated at times with coat color. Color dilute animals may lack part or all of the tapetum which results in showing of the choroidal vessels beneath.
  - The non-tapetal color is a variation of brown color.



Penn Veterinary Medicine

Horse

- Normal Equine Fundus
  - Similar variations of normal as seen in the dog and cat can occur (atapetal, lack of RPE pigment, Tigroid fundus, etc.



Penn Veterinary Medicine

Penn Veterinary Medicine

Start Looking at Retinas Today

The best way to learn what abnormal looks like is to take the time to examine as many normal animals as you can to understand normal and variations of normal.

Then the abnormal will be obvious!

Have Fun!!

James V. Schoster, DVM DACVO