In creating/revising this slide-set, I consulted the four BCSC books that have a lot to say on the subject: *Fundamentals, Neuro-Oph, Path and Glaucoma*. Unfortunately, all four differed from one another regarding many aspects of optic nerve anatomy. Some of these differences were trivial; others not so much.

As a comprehensive ophthalmologist, I have no familiarity with the primary literature concerning ophthalmic anatomy and histology. Thus, *I am in no position to declare which book is correct regarding points on which they differ*. The following slides represent my best attempt at compiling the disparate information in a manner that is reasonable and memorable. (As a matter of both interest and information, I have included some of the differing answers regarding certain aspects of the nerve.)

My main point: When answering questions regarding the optic nerve—whether such questions occur in a pimping session, on the OKAP or during the Boards—adopt and maintain a stance of flexibility.
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**tl;dr:**
--When asked an optic-nerve question requiring a numeric response, phrase your answer along these lines: ‘Well, bearing in mind the considerable anatomic variability that characterizes the optic nerve, a reasonable estimate would be x.’
--When asked a question about optic-nerve vasculature, begin your response with ‘Bearing in mind that there is not universal agreement regarding this, many experts believe…’

My main point: When answering questions regarding the optic nerve--whether such questions occur in a pimping session, on the OKAP or during the Boards--adopt and maintain a stance of flexibility.
The optic nerves are composed of what?
The optic nerves are composed of what?
The axons of retinal ganglion cells
The optic nerves are composed of what?

The axons of retinal ganglion cells

How many fibers (axons) comprise an optic nerve?
The optic nerves are composed of what?

- The axons of retinal ganglion cells

How many fibers (axons) comprise an optic nerve?

- Depends upon which book you ask, but the answer 1.2M works

- Glaucoma book: 1.2-1.5M
- Neuro: 1-1.2M
- Fundamentals: “more than a million”
The optic nerves are composed of what?
The axons of retinal ganglion cells

Do they synapse in the region of the optic nerve head?
The optic nerves are composed of what?
The axons of retinal ganglion cells

Do they synapse in the region of the optic nerve head?
No
**The Optic Nerve**

The optic nerves are composed of what?
The axons of retinal ganglion cells

*Do they synapse in the region of the optic nerve head?*
No

*Where will they synapse?*
The optic nerves are composed of what?
The axons of retinal ganglion cells

Do they synapse in the region of the optic nerve head?
No

Where will they synapse?
Most will synapse in the lateral geniculate nucleus (LGN)
The optic nerves are composed of what?
The axons of retinal ganglion cells

Do they synapse in the region of the optic nerve head?
No

Where will they synapse?
Most will synapse in the lateral geniculate nucleus (LGN)

Most? Where will the others synapse, and what are they responsible for?
The optic nerves are composed of what?
The axons of retinal ganglion cells

Do they synapse in the region of the optic nerve head?
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Where will they synapse?
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Most of the others are involved in the pupillary light reflex; they peel off just prior to reaching the LGN, heading instead to the pretectum of the dorsal midbrain to synapse in the pretectal nuclei.
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‘Most’? Where will the others synapse, and what are they responsible for?
The hypothalamus, where they are involved in modulating circadian responses
The optic nerves are composed of what?
The axons of retinal ganglion cells

Do they synapse in the region of the optic nerve head?
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Parinaud syndrome
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involved in the pupillary light reflex, the pretectum

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What is the classic pupil finding in Parinaud syndrome?
Light-near dissociation
The optic nerves are composed of what?
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Do they synapse in the region of the optic nerve head?
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What is the classic pupil finding in Parinaud syndrome?
Light-near dissociation

What is light-near dissociation?
A phenomena in which the pupils miose less robustly in response to light than they do as part of the near response
The optic nerves are composed of what?
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Do they synapse in the region of the optic nerve head?
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What is light-near dissociation?
A phenomena in which the pupils miosis less robustly in response to light than they do as part of the near response.

The near response is often referred to by what number-related name?
The near triad
The optic nerves are composed of what?
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A phenomena in which the pupils miuse less robustly in response to light than they do as part of the near response.

What is the near response often referred to by what number-related name?
The near triad

What is the near triad?
Light-near dissociation, convergence, accommodation

Other than miosis, what are the other ocular responses of the near triad?
-- Miosis
-- Convergence
-- Accommodation
The optic nerves are composed of what?
The axons of retinal ganglion cells

Do they synapse in the region of the optic nerve head? No

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Parinaud syndrome

What is the classic pupil finding in Parinaud syndrome?
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What are the two noneponymous names for Parinaud syndrome?
1) Dorsal midbrain syndrome 2) Pretectal syndrome

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Other than miosis, what are the other ocular responses of the near triad?
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Anatomically speaking, the optic nerve is considered to have four portions. What are they?
Optic nerve (don’t memorize the lengths)
Anatomically speaking, the optic nerve is considered to have four portions. What are they? How long is each?

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*Fundamentals: 4-10  Path: 4-10  Neuro: 8-10*
Anatomically speaking, the optic nerve is considered to have four portions. What are they? **How long is each?**

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Fundamentals: 10  
Path: 10  
Neuro: 8-12
Anatomically speaking, the optic nerve is considered to have four portions. What are they?

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How long is the distance between the back of the eye and the orbital apex?

About 18 mm
Anatomically speaking, the optic nerve is considered to have four portions. What are they?

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How long is the distance between the back of the eye and the orbital apex? About 18 mm
Anatomically speaking, the optic nerve is considered to have four portions. What are they? How long is each?

**The intraocular portion is also considered to have four portions. What are they?**

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*The intraocular portion is also considered to have four portions. What are they?*
Anatomically speaking, the optic nerve is considered to have four portions. What are they? How long is each?

*The intraocular portion is also considered to have four portions. What are they?*

### Anatomical Portions of the Optic Nerve

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Q/A

Anatomically speaking, the optic nerve is considered to have four portions. What are they? How long is each?

*The intraocular portion is also considered to have four portions. What are they?*
Anatomically speaking, the optic nerve is considered to have four portions. What are they? How long is each?

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**Diagram:**

1. **NFL portion** (innermost)
2. **Pre-laminar**
3. **Laminar**
4. **Retrolaminar** (outermost)
The Optic Nerve

Optic nerve: Intraocular portion
Anatomically speaking, the optic nerve is considered to have four portions. What are they? How long is each?

To what lamina is this referring?

The intraocular portion is also considered to have four portions. What are they? What is the blood supply for each?
Anatomically speaking, the optic nerve is considered to have four portions. What are they? How long is each? The intraocular portion is also considered to have four portions. What are they? What is the blood supply for each? To what lamina is this referring? The lamina cribrosa.

### Portion Length (mm)

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- **Pre-laminar**
- **Laminar**
- **Retrolaminar**

_The Optic Nerve_
Anatomically speaking, the optic nerve is considered to have four portions. What are they? How long is each?

The intraocular portion is also considered to have four portions. What are they? The blood supply for each?

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The Optic Nerve

To what lamina is this referring? The lamina cribrosa

Lamina cribrosa? I thought that was the super-thin part of the medial orbital wall.

(outermost) Pre-laminar Laminar Retrolaminar

The lamina cribrosa

The fenestrated hole in the posterior sclera through which the optic nerve exits

Does the lamina extend the entire thickness of the eye wall? No, it is about 1/3 the thickness of the adjacent sclera

Lamina cribrosa? I thought that was the super-thin part of the medial orbital wall.
Anatomically speaking, the optic nerve is considered to have four portions. What are they?

How long is each portion?

The intraocular portion is also considered to have four portions. What are they? What is the blood supply for each?

A

The Optic Nerve

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To what lamina is this referring?

The lamina cribrosa

Lamina cribrosa? I thought that was the super-thin part of the medial orbital wall. You’re thinking of the lamina papyracea.

To what lamina is this referring?

The lamina cribrosa

Anatomically speaking, the lamina cribrosa is the fenestrated hole in the posterior sclera through which the optic nerve exits.
Anatomically speaking, the optic nerve is considered to have four portions. What are they?

How long is each?

- Intraocular: 1 mm
- Orbital: 30 mm
- Canalicular: 10 mm
- Intracranial: 10 mm

What is the blood supply for each?

To what lamina is this referring?

The lamina cribrosa

What is the lamina cribrosa?

The fenestrated hole in the posterior sclera through which the optic nerve exits. Does the lamina extend the entire thickness of the eye wall? No, it is about 1/3 the thickness of the adjacent sclera.
Anatomically speaking, the optic nerve is considered to have four portions. What are they? How long is each?
The intraocular portion is also considered to have four portions. What are they? What is the blood supply for each? (innermost) (outermost)

To what lamina is this referring?
The lamina cribrosa

What is the lamina cribrosa?
The fenestrated hole in the posterior sclera through which the optic nerve exits

<table>
<thead>
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</table>

The Optic Nerve

1. Pre-laminar
2. Laminar
3. Retrolaminar
Anatomically speaking, the optic nerve is considered to have four portions. What are they? How long is each? The intraocular portion is also considered to have four portions. What are they? What is the blood supply for each?

**The Optic Nerve**

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</table>

To what lamina is this referring? The **lamina cribrosa**

What is the lamina cribrosa? The **fenestrated** hole in the posterior sclera through which the optic nerve exits.

How many fenestrations are there? 200-300

Innermost

<table>
<thead>
<tr>
<th>Pre-laminar</th>
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<tbody>
<tr>
<td>Laminar</td>
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<tr>
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Anatomically speaking, the optic nerve is considered to have four portions. What are they?

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The intraocular portion is also considered to have four portions. What are they?

To what lamina is this referring?

The lamina cribrosa

What is the lamina cribrosa?

The fenestrated hole in the posterior sclera through which the optic nerve exits

How many fenestrations are there?

200-300

The Optic Nerve

**Pre-laminar**

**Laminar**

**Retrolaminar**
Anatomically speaking, the optic nerve is considered to have four portions. What are they?

The intraocular portion is also considered to have four portions. What are they?

What is the blood supply for each?

To what lamina is this referring?

The lamina cribrosa

What is the lamina cribrosa?

The fenestrated hole in the posterior sclera through which the optic nerve exits

How many fenestrations are there?

200-300

Two fenestrations are much larger than the others. What passes through the larger ones?
Anatomically speaking, the optic nerve is considered to have four portions. What are they? The intraocular portion is also considered to have four portions. What are they? The blood supply for each is as follows:

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To what lamina is this referring? The lamina cribrosa. What is the lamina cribrosa? The fenestrated hole in the posterior sclera through which the optic nerve exits. How many fenestrations are there? 200-300. Two fenestrations are much larger than the others. What passes through the larger ones? The central retinal artery and vein.
The Optic Nerve

Lamina cribrosa

Lamina cribrosa

Central Retinal Vessels
The Optic Nerve

Anatomically speaking, the optic nerve is considered to have four portions. What are they? How long is each?

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The intraocular portion is also considered to have four portions. What are they? What is the blood supply for each?

To what lamina is this referring? The lamina cribrosa

What is the lamina cribrosa? The fenestrated hole in the posterior sclera through which the optic nerve exits.

Does the lamina extend the entire thickness of the eye wall?

Q
Anatomically speaking, the optic nerve is considered to have four portions. What are they? How long is each?

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The intraocular portion is also considered to have four portions. What are they? What is the blood supply for each?

To what lamina is this referring?

The **lamina cribrosa**

What is the lamina cribrosa?
The fenestrated hole in the posterior sclera through which the optic nerve exits

Does the lamina extend the entire thickness of the eye wall?
No, it is about 1/3 the thickness of the adjacent sclera
Anatomically speaking, the optic nerve is considered to have four portions. What are they? How long is each?

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The intraocular portion is also considered to have four portions. What are they? What is the blood supply for each?

**The Optic Nerve**

To what lamina is this referring? The lamina cribrosa

What is the lamina cribrosa? The fenestrated hole in the posterior sclera through which the optic nerve exits

Does the lamina extend the entire thickness of the eye wall? No, it is about 1/3 the thickness of the adjacent sclera

With which portion of the eye wall is the lamina aligned; ie, is it the inner third, the middle third or the outer third?
Anatomically speaking, the optic nerve is considered to have four portions. What are they?

How long is each?

- Intraocular 1 mm
- Orbital 30 mm
- Canalicular 10 mm
- Intracranial 10 mm

To what lamina is this referring?
The lamina cribrosa

What is the lamina cribrosa?
The fenestrated hole in the posterior sclera through which the optic nerve exits

Does the lamina extend the entire thickness of the eye wall?
No, it is about 1/3 the thickness of the adjacent sclera

With which portion of the eye wall is the lamina aligned; i.e., is it the inner third, the middle third or the outer third?
The inner third

*The Optic Nerve*

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The intraocular portion is also considered to have four portions. What are they? **What is the blood supply for each?**

### Portion Length (mm)

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### Blood supply

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<td>?</td>
</tr>
<tr>
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What is the blood supply for each?

### The Optic Nerve

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**What is the blood supply for each?**

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What is the blood supply for each?

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### Optic Nerve Table

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</table>
Intraocular optic nerve: Blood supply
Anatomically speaking, the optic nerve is considered to have four portions. What are they? How long is each?

The intraocular nerve also has four portions. What are they?

To which portion(s) of the intraocular nerve does the term optic disc apply?

---

### The Optic Nerve

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**Blood supply**

- **NFL portion?**
  - Central retinal artery (CRA)
- **Pre-laminar?**
  - Short posterior ciliary arteries
- **Laminar?**
  - Arterial circle of Zinn & Haller
- **Retrolaminar?**
  - Centripetal CRA branches, centrifugal pial branches
Anatomically speaking, the optic nerve is considered to have four portions. What are they? How long is each?

To which portion(s) of the intraocular nerve does the term optic disc apply?

The portion visible on ophthalmoscopy, ie, the NFL

The Optic Nerve

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Anatomically speaking, the optic nerve is considered to have four portions. What are they? How long is each?

To which portion(s) of the intraocular nerve does the term optic disc apply? The portion visible on ophthalmoscopy, ie, the NFL

What is the diameter of the optic disc?

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The Optic Nerve
Anatomically speaking, the optic nerve is considered to have four portions. What are they? How long is each?

To which portion(s) of the intraocular nerve does the term optic disc apply? The portion visible on ophthalmoscopy, ie, the NFL

What is the diameter of the optic disc? Well, bearing in mind the considerable anatomic variability that characterizes the optic nerve, a reasonable estimate would be 1.6 mm, with the vertical diameter usually a little larger than the horizontal.

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To which portion(s) of the intraocular nerve does the term NFL portion apply? The NFL portion

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Anatomically speaking, the optic nerve is considered to have four portions. What are they? How long is each?

The intraocular portion is also considered to have four portions. What are they? What is the blood supply for each?

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### The Optic Nerve

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To which portion(s) of the intraocular nerve does the term **optic disc** apply? The portion visible on ophthalmoscopy, i.e., the NFL.

---

What is the diameter of the optic disc? Well, bearing in mind the considerable anatomic variability that characterizes the optic nerve, a reasonable estimate would be 1.6 mm, with the vertical diameter usually a little larger than the horizontal.

---

What is the diameter of the nerve after it passes through the lamina cribrosa? It doubles to 3-4 mm or so. Why does it double in size? Because it is at this point the fibers become myelinated.

---

What is the diameter of the nerve after it passes through the lamina cribrosa?
Anatomically speaking, the optic nerve is considered to have four portions. What are they? How long is each?

The intraocular portion is divided into four parts. What are they?

To which portion(s) of the intraocular nerve does the term optic disc apply? The portion visible on ophthalmoscopy, i.e., the NFL.

What is the diameter of the optic disc? Well, bearing in mind the considerable anatomic variability that characterizes the optic nerve, a reasonable estimate would be 1.6 mm, with the vertical diameter usually a little larger than the horizontal.

What is the diameter of the nerve after it passes through the lamina cribrosa? It doubles to 3-4 mm or so.

### The Optic Nerve

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*To be continued...*
Anatomically speaking, the optic nerve is considered to have four portions. What are they? How long is each?

The intraocular portion is also considered to have four portions. What are they? What is the blood supply for each?

**Anatomically speaking, the optic nerve is considered to have four portions. What are they? How long is each?**

To which portion(s) of the intraocular nerve does the term optic disc apply? The portion visible on ophthalmoscopy, ie, the NFL

What is the diameter of the optic disc? Well, bearing in mind the considerable anatomic variability that characterizes the optic nerve, a reasonable estimate would be 1.6 mm, with the vertical diameter usually a little longer than the horizontal.

What is the diameter of the nerve after it passes through the lamina cribrosa? It doubles to 3-4 mm or so

Why does it double in size?

**Centipetal CRA branches, centrifugal pial branches**

### The Optic Nerve

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**Portion**

- (innermost) NFL portion, central retinal artery (CRA)
- Pre-laminar: short posterior ciliary arteries
- Laminar: arterial circle of Zinn & Haller
- Retrolaminar: centripetal CRA branches, centrifugal pial branches

**Q**

To which portion(s) of the intraocular nerve does the term optic disc apply? The portion visible on ophthalmoscopy, ie, the NFL

What is the diameter of the optic disc? Well, bearing in mind the considerable anatomic variability that characterizes the optic nerve, a reasonable estimate would be 1.6 mm, with the vertical diameter usually a little longer than the horizontal.

What is the diameter of the nerve after it passes through the lamina cribrosa? It doubles to 3-4 mm or so

Why does it double in size?
Anatomically speaking, the optic nerve is considered to have four portions. What are they? How long is each?

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To which portion(s) of the intraocular nerve does the term **optic disc** apply? The portion visible on ophthalmoscopy, ie, the NFL.

What is the diameter of the optic disc? Well, bearing in mind the considerable anatomic variability that characterizes the optic nerve, a reasonable estimate would be 1.6 mm, with the vertical diameter usually a little larger than the horizontal.

What is the diameter of the nerve after it passes through the lamina cribrosa? It doubles to 3-4 mm or so.

Why does it double in size? Because it as at this point the fibers become myelinated.
### The Optic Nerve

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Anatomically speaking, the optic nerve is considered to have four portions. What are they? How long is each?

**To which portion(s) of the intraocular nerve does the term optic disc apply?**

The portion visible on ophthalmoscopy, ie, the NFL.

**What is the diameter of the optic disc?**

Well, bearing in mind the considerable anatomic variability that characterizes the optic nerve, a reasonable estimate would be 1.6 mm, with the vertical diameter usually a little larger than the horizontal.

**What is the diameter of the nerve after it passes through the lamina cribrosa?**

It doubles to 3-4 mm or so.

**Why does it double in size?**

Because it is at this point the fibers become myelinated.

**Which portion(s) of the intraocular nerve are supplied by the NFL?**

Retrolaminar

The NFL portion

Centripetal CRA branches, centrifugal pial branches
Anatomically speaking, the optic nerve is considered to have four portions. What are they?

How long is each?

- Intraocular: 1 mm
- Orbital: 30 mm
- Canalicular: 10 mm
- Intracranial: 10 mm

The intraocular portion is also considered to have four portions. What are they?

What is the blood supply for each?

The term optic disc applies to which portion(s) of the intraocular nerve?

- The portion visible on ophthalmoscopy, i.e., the NFL

What is the diameter of the optic disc?

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Why does it double in size?

Because it is at this point the fibers become myelinated.

Can myelin appear prior to this point?

Yes.

When myelinated retinal nerve fibers are present, what are they called?

They are called 'myelinated retinal nerve fibers'.

What is the ophthalmoscopic appearance of myelinated retinal nerve fibers?

They appear as white patches usually near the optic disc.

How large are the patches?

It varies widely—they can be very big, or very small.

Can multiple patches be present in the same eye?

Yes.
Anatomically speaking, the optic nerve is considered to have four portions. What are they?

How long is each?
The intraocular portion is also considered to have four portions. What are they?

What is the blood supply for each?

Portion Blood supply
NFL portion Central retinal artery (CRA)
Pre-laminar Short posterior ciliary arteries
Laminar Arterial circle of Zinn & Haller
Retrolaminar Centripetal CRA branches, centrifugal pial branches

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Can myelin appear prior to this point?
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Why does it double in size?
Because it is at this point the fibers become myelinated

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How large are the patches?
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Can multiple patches be present in the same eye?
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Anatomically speaking, the optic nerve is considered to have four portions. What are they? The intraocular portion is also considered to have four portions. What are they? What is the blood supply for each?

### Portion Length (mm)

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Can myelin appear prior to this point? Yes.

When myelinated retinal nerve fibers are present, what are they called? They are called 'myelinated retinal nerve fibers'.

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Anatomically speaking, the optic nerve is considered to have four portions. What are they?

- Intraocular
- Orbital
- Canalicular
- Intracranial

How long is each?

- Intraocular: 1 mm
- Orbital: 30 mm
- Canalicular: 10 mm
- Intracranial: 10 mm

The intraocular portion is also considered to have four portions. What are they?

- Portion
- Length (mm)
- Intraocular
- 1
- Orbital
- 30
- Canalicular
- 10
- Intracranial
- 10

What is the blood supply for each?

- Portion Blood supply
- NFL portion Central retinal artery (CRA)
- Pre-laminar Short posterior ciliary arteries
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- Retrolaminar Centripetal CRA branches, centrifugal pial branches

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Can multiple patches be present in the same eye? Yes.
Anatomically speaking, the optic nerve is considered to have four portions. What are they?

The portion visible on ophthalmoscopy, ie, the NFL

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Can myelin appear prior to this point?

Yes

When myelinated retinal nerve fibers are present, what are they called?

They are called 'myelinated retinal nerve fibers'

What word is sometimes used instead of myelinated?

Medullated retinal nerve fibers

Q

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Portion Blood supply

NFL portion Central retinal artery (CRA) Pre-laminar Short posterior ciliary arteries Laminar Arterial circle of Zinn & Haller Retrolaminar Centripetal CRA branches, centrifugal pial branches

The Optic Nerve

To which portion(s) of the intraocular nerve does the term optic disc apply?

The portion visible on ophthalmoscopy, ie, the NFL

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How large are the patches?

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Can multiple patches be present in the same eye?

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What word is sometimes used instead of myelinated?

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at this point the fibers become myelinated

Retrolaminar

Centripetal CRA branches, centrifugal pial branches

80
Anatomically speaking, the optic nerve is considered to have four portions. What are they? The intraocular portion is also considered to have four portions. What are they? What is the blood supply for each?

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The Optic Nerve

Can myelin appear prior to this point? Yes

What word is sometimes used instead of myelinated? Medullated retinal nerve fibers

What is the diameter of the optic disc? A reasonable estimate would be 1.6 mm, with the vertical diameter usually slightly larger than the horizontal.

What is the diameter of the nerve after it passes through the lamina cribrosa? It doubles to 3-4 mm or so.

Why does it double in size? Because at this point the fibers become myelinated.

Can myelin appear prior to this point? Yes

What word is sometimes used instead of myelinated? Medullated retinal nerve fibers

What is the ophthalmoscopic appearance of medullated retinal nerve fibers? They appear as white patches usually near the optic disc.

How large are the patches? It varies widely—very big or very small.

Can multiple patches be present in the same eye? Yes.

What word is sometimes used instead of medullated? Myelinated retinal nerve fibers.
### The Optic Nerve

#### Portions and Lengths

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#### Blood Supply

- NFL portion
- Central retinal artery (CRA)
- Pre-laminar short posterior ciliary arteries
- Laminar arterial circle of Zinn & Haller
- Retrolaminar
- Centripetal CRA branches, centrifugal pial branches

#### Optic Disc
- The portion visible on ophthalmoscopy, i.e., the NFL

#### Diameter of Optic Disc
- Approximately 1.6 mm, with the vertical diameter usually a little larger than the horizontal.

#### Diameter After Lamina Cribrosa
- Doubles to 3-4 mm or so

#### Myelination
- Can myelin appear prior to this point?
  - Yes
- When myelinated retinal nerve fibers are present, what are they called?
  - They are called ‘myelinated retinal nerve fibers’
- What is the ophthalmoscopic appearance of myelinated retinal nerve fibers?
  - They appear as white patches usually near the optic disc
- How large are the patches?
  - It varies widely—can be very big, or very small
- Can multiple patches be present in the same eye?
  - Yes

---

**Q**

**Q:** Why does it double in size at this point?

**A:** Because fibers become myelinated at this point. Myelin can appear prior to this point, but at this point, the fibers become myelinated, increasing the diameter of the nerve.
Anatomically speaking, the optic nerve is considered to have four portions. What are they? The intraocular portion is also considered to have four portions. What are they? What is the blood supply for each?

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Can myelin appear prior to this point? Yes

When myelinated retinal nerve fibers are present, what are they called? They are called ‘myelinated retinal nerve fibers’

What is the ophthalmoscopic appearance of myelinated retinal nerve fibers? They appear as white patches usually near the optic disc.
Myelinated retinal nerve fiber layer
Anatomically speaking, the optic nerve is considered to have four portions. What are they? The intraocular portion is also considered to have four portions. What are they? What is the blood supply for each?

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What is the ophthalmoscopic appearance of myelinated retinal nerve fibers? They appear as white patches usually near the optic disc

How large are the patches? It varies widely— they can be very big, or very small

Can multiple patches be present in the same eye? Yes
Anatomically speaking, the optic nerve is considered to have four portions. What are they?

The intraocular portion is also considered to have four portions. What are they?

What is the blood supply for each?

To which portion(s) of the intraocular nerve does the term optic disc apply?

The portion visible on ophthalmoscopy, ie, the NFL

What is the diameter of the optic disc?

Well, bearing in mind the considerable anatomic variability that characterizes the optic nerve, a reasonable estimate would be 1.6 mm, with the vertical diameter usually a little larger than the horizontal.

What is the diameter of the nerve after it passes through the lamina cribrosa?

It doubles to 3-4 mm or so. Why does it double in size? Because it is at this point that the fibers become myelinated.

Can myelin appear prior to this point?

Yes.

When myelinated retinal nerve fibers are present, what are they called?

They are called ‘myelinated retinal nerve fibers’.

What is the ophthalmoscopic appearance of myelinated retinal nerve fibers?

They appear as white patches usually near the optic disc.

How large are the patches?

It varies widely—they can be very big, or very small.

Can multiple patches be present in the same eye?

Yes.

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Myelinated retinal nerve fiber layer: Very big, and very small

The Optic Nerve
Anatomically speaking, the optic nerve is considered to have four portions. What are they?

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The intraocular portion is also considered to have four portions. What are they?

- NFL portion
- Pre-laminar
- Laminar
- Retrolaminar

What is the blood supply for each?

- NFL portion: Central retinal artery (CRA)
- Pre-laminar: Short posterior ciliary arteries
- Laminar: Arterial circle of Zinn & Haller
- Retrolaminar: Centripetal CRA branches, centrifugal pial branches

Can myelin appear prior to this point?
Yes

When myelinated retinal nerve fibers are present, what are they called?
They are called ‘myelinated retinal nerve fibers’

What is the ophthalmoscopic appearance of myelinated retinal nerve fibers?
They appear as white patches usually near the optic disc

How large are the patches?
It varies widely—some can be very big, or very small

Can multiple patches be present in the same eye?
Yes

Why does it double in size at this point?
Because the fibers become myelinated

What is the diameter of the optic disc?
Well, bearing in mind the considerable anatomic variability that characterizes the optic nerve, a reasonable estimate would be 1.6 mm, with the vertical diameter usually a little larger than the horizontal.

What is the diameter of the nerve after it passes through the lamina cribrosa?
It doubles to 3–4 mm or so

Why does it double in size?
Because fibers become myelinated.

When myelinated retinal nerve fibers are present, what are they called?
They are called myelinated retinal nerve fibers.
Portion Blood supply
CEA pre-laminar, centripetal(CRAB)
CRAB laminar, circular of Zinn & Haller
CRA retrolaminar, centrifugal pial branches

Portion Length (mm)
Intraocular 1
Orbital 30
Canalicular 10
Intracranial 10

Anatomically speaking, the optic nerve is considered to have four portions. What are they?

How long is each?
The intraocular portion is also considered to have four portions. What are they?

What is the blood supply for each?

Can myelin appear prior to this point?
Yes

When myelinated retinal nerve fibers are present, what are they called?
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What is the ophthalmoscopic appearance of myelinated retinal nerve fibers?
They appear as white patches usually near the optic disc

How large are the patches?
It varies widely--they can be very big, or very small

Can multiple patches be present in the same eye?
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Why does it double in size?
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The Optic Nerve

To which portion(s) of the intraocular nerve does the term optic disc apply?

The portion visible on ophthalmoscopy, ie, the NFL

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When myelinated retinal nerve fibers are present, what are they called?
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What is the ophthalmoscopic appearance of myelinated retinal nerve fibers?
They appear as white patches usually near the optic disc

How large are the patches?
It varies widely--they can be very big, or very small

Can multiple patches be present in the same eye?
Yes

Why does it double in size?
Because it is at this point the fibers become myelinated

Retrolaminar

Centripetal CRA branches, centrifugal pial branches
The Optic Nerve

Myelinated retinal nerve fiber layer: Multiple
Anatomically speaking, the optic nerve is considered to have four portions. What are they?

The intraocular portion is also considered to have four portions. What are they?

What is the blood supply for each?

In addition to myelin, the retrolaminar optic nerve acquires something else of significance. What?

Can multiple patches be present in the same eye?
Yes

Why does it double in size?
Because the fibers become myelinated

Retrolaminar
Centripetal CRA branches, centrifugal pial branches
Anatomically speaking, the optic nerve is considered to have four portions. What are they?

The intraocular portion is also considered to have four portions. What are they?

What is the blood supply for each?

In addition to myelin, the retrolaminar optic nerve acquires something else of significance. What? Its meningeal sheaths

Can multiple patches be present in the same eye? Yes

Why does it double in size? Because it is myelinated

at this point the fibers become myelinated

The Optic Nerve

Intraocular | Length (mm)
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Intraocular | 1

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The Optic Nerve

To which portion(s) of the intraocular nerve does the term optic disc apply?

The portion visible on ophthalmoscopy, ie, the NFL

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It varies widely— they can be very big, or very small

Can multiple patches be present in the same eye?

Yes

In addition to myelin, the retrolaminar optic nerve acquires something else of significance. What?

Its meningeal sheaths

Does it pick up all three meningeal layers?

Yes

Does it have a subarachnoid space, and if so, is this space filled with CSF?

Yes and yes

Is the CSF-filled subarachnoid space of the retrolaminar optic nerve continuous with the CSF-filled subarachnoid space of the rest of the CNS?

Yes

How does the pressure in the CSF-filled subarachnoid space of the retrolaminar optic nerve compare to that of the CSF-filled subarachnoid space of the rest of the CNS (ie, compared to intracranial pressure, ICP)?

They are exactly the same
The Optic Nerve

In addition to myelin, the retrolaminar optic nerve acquires something else of significance. What? Its meningeal sheaths

Does it pick up all three meningeal layers?

Can multiple patches be present in the same eye? Yes

Why does it double in size? Because it is at this point the fibers become myelinated

Portion Blood supply

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How large are the patches? It varies widely—they can be very big, or very small

Can multiple patches be present in the same eye? Yes
Anatomically speaking, the optic nerve is considered to have four portions. What are they? How long is each? The intraocular portion is also considered to have four portions. What are they? What is the blood supply for each?

In addition to myelin, the retrolaminar optic nerve acquires something else of significance. What? Its meningeal sheaths. Does it pick up all three meningeal layers? Yes. Can multiple patches be present in the same eye? Yes. Why does it double in size? Because it is at this point the fibers become myelinated. What is the ophthalmoscopic appearance of myelinated retinal nerve fibers? They appear as white patches usually near the optic disc. How large are the patches? It varies widely—they can be very big, or very small. Can multiple patches be present in the same eye? Yes. In addition to myelin, the retrolaminar optic nerve acquires something else of significance. What? Its meningeal sheaths. Does it pick up all three meningeal layers? Yes. Does it have a subarachnoid space, and if so, is this space filled with CSF? Yes and yes. Is the CSF-filled subarachnoid space of the retrolaminar optic nerve continuous with the CSF-filled subarachnoid space of the rest of the CNS? Yes. How does the pressure in the CSF-filled subarachnoid space of the retrolaminar optic nerve compare to that of the CSF-filled subarachnoid space of the rest of the CNS (ie, compared to intracranial pressure, ICP)? They are exactly the same.
Retrolaminar optic nerve: Meninges
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When myelinated retinal nerve fibers are present, what are they called? They are called 'myelinated retinal nerve fibers'

What is the ophthalmoscopic appearance of myelinated retinal nerve fibers? They appear as white patches usually near the optic disc

How large are the patches? It varies widely--they can be very big, or very small

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The Optic Nerve

Port Blood supply

NFL portion Central retinal artery (CRA)

Pre-laminar Short posterior ciliary arteries

Laminar Arterial circle of Zinn & Haller

Retrolaminar Centripetal CRA branches, centrifugal pial branches
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Can multiple patches be present in the same eye?
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Why does it double in size at this point?
Because fibers become myelinated.
Anatomically speaking, the optic nerve is considered to have four portions. What are they?

How long is each?

The intraocular portion is also considered to have four portions. What are they?

What is the blood supply for each?

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Because fibers become myelinated at this point.

What is the ophthalmoscopic appearance of myelinated retinal nerve fibers?
They appear as white patches usually near the optic disc.

How large are the patches?
It varies widely—they can be very big, or very small.

Can multiple patches be present in the same eye?
Yes.

Can myelin appear prior to this point?
Yes.

When myelinated retinal nerve fibers are present, what are they called?
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What is the diameter of the optic disc?
Well, bearing in mind the considerable anatomic variability that characterizes the optic nerve, a reasonable estimate would be 1.6 mm, with the vertical diameter usually a little larger than the horizontal.

What is the diameter of the nerve after it passes through the lamina cribrosa?
It doubles to 3-4 mm or so.

Can myelin appear prior to this point?
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What is the blood supply for each?

In addition to myelin, the retrolaminar optic nerve acquires something else of significance. What?

Its meningeal sheaths

Does it pick up all three meningeal layers?

Yes

Does it have a subarachnoid space, and if so, is this space filled with CSF?

How far forward in the optic nerve does the CSF-filled space extend, ie, what structure provides the anterior limit to the space?

Subarachnoid space of the rest of the CNS?

Yes

How does the pressure in the CSF-filled subarachnoid space of the retrolaminar optic nerve compare to that of the CSF-filled subarachnoid space of the rest of the CNS (ie, compared to intracranial pressure, ICP)?

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Does it have a subarachnoid space, and if so, is this space filled with CSF? Yes and yes.

How far forward in the optic nerve does the CSF-filled space extend, i.e., what structure provides the anterior limit to the space?

The lamina cribrosa (which also is the structure delimiting the anterior extent of the retrolaminar space).

Subarachnoid space of the rest of the CNS? Yes.

How does the pressure in the CSF-filled subarachnoid space of the retrolaminar optic nerve compare to that of the CSF-filled subarachnoid space of the rest of the CNS (i.e., compared to intracranial pressure, ICP)? They are exactly the same.

Can multiple patches be present in the same eye? Yes.

Why does it double in size? Because it is at this point the fibers become myelinated.

The Optic Nerve

Intraocular

Retrolaminar

Centripetal CRA branches, centrifugal pial branches

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### The Optic Nerve

#### Portion Length (mm)

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#### Blood supply

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To which portion(s) of the intraocular nerve does the term optic nerve head apply?
Anatomically speaking, the optic nerve is considered to have four portions. What are they? How long is each?

The intraocular portion is also considered to have four portions. What are they? What is the blood supply for each?

To which portion(s) of the intraocular nerve does the term optic nerve head apply? This one is tougher to answer. The *Glaucoma* book treats the terms optic nerve head and optic disc as synonyms. The *Fundamentals* book initially does as well…

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**Portion** | **Blood supply**
---|---
NFL portion | Central retinal artery (CRA)
Pre-laminar | Short posterior ciliary arteries
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*Glaucoma Fundamentals*
The Optic Nerve

### Anatomically Speaking

The optic nerve is considered to have four portions. What are they? How long is each?

### Intraocular Portion

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### Blood Supply

- **NFL portion**: Central retinal artery (CRA)
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- **Retrolaminar**: Centripetal CRA branches, centrifugal pial branches

*To which portion(s) of the intraocular nerve does the term optic nerve head apply?*

This one is tougher to answer. The Glaucoma book treats the terms optic nerve head and optic disc as synonyms. The *Fundamentals* book initially does as well... but three pages later states that the nerve head is synonymous with the **entire** intraocular portion of the nerve.
Anatomically speaking, the optic nerve is considered to have four portions. What are they?

One useful way to think about the layers of the intraocular portion of the optic nerve is to relate them to the tissue surrounding them. Obviously, the laminar layer is surrounded by the lamina cribrosa. What are the others surrounded by?
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### Surrounded by...

- **NFL portion**: Retina
- **Pre-laminar**: Choroid
- **Laminar**: Lamina cribrosa
- **Retrolaminar**: ?
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Disc edema secondary to increased ICP
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Where along the course of the optic nerve does ICP exert its nefarious influence?
Define papilledema.
Disc edema secondary to increased ICP

Where along the course of the optic nerve does ICP exert its nefarious influence?
As anterior as it can go--the posterior aspect of the lamina cribrosa
Define papilledema.
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How does increased pressure at the lamina lead to edema of the optic disc?
Define papilledema.
Disc edema secondary to increased ICP

Where along the course of the optic nerve does ICP exert its nefarious influence?
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How does increased pressure at the lamina lead to edema of the optic disc?
By interfering with anterograde axoplasmic flow. (Remember, the optic nerve fibers are simply the axons of retinal ganglion cells.) Axoplasmic stasis at the lamina cribrosa leads to swelling of the fibers in the pre-laminar and NFL portion of the nerve, which in the aggregate manifests as disc edema. Fiber swelling may also compromise blood flow to the pre-laminar/NFL portions of the nerve, which could lead to further axon compromise (and therefore further swelling) as well as fluid accumulation (ditto).
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Is papilledema a unilateral, or bilateral condition?
Define papilledema.
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Is papilledema a unilateral, or bilateral condition?
Absent pre-existing damage to one nerve, it is almost always bilateral
The Optic Nerve

Papilledema
**The Optic Nerve**

**Q**

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Disc edema secondary to increased ICP

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*There is a classic syndrome which presents with unilateral papilledema--what is it?*
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Is papilledema a unilateral, or bilateral condition?
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There is a classic syndrome which presents with unilateral papilledema--what is it?
Foster Kennedy syndrome (FKS)
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What is the pathophysiology of FKS?
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What is the pathophysiology of FKS?
An intracranial mass is located such as to compress one optic nerve, thereby causing it to atrophy. By dint of its space-occupying capacity, the mass increases ICP enough to induce papilledema in the other, non-atrophied optic nerve. Ergo, unilateral papilledema.
Foster Kennedy Syndrome in a 52-year-old woman (A) Fundus picture of the right eye showing optic disc pallor. (B) Fundus picture of the left eye showing disc edema with tortuosity of the peripapillary vessels. (C & D) T2 weighted MRI images in axial and sagittal view demonstrating a extra-axial, well circumscribed, homogenous, isointense mass lesion in the fronto-parietal cortex with broad based dural attachment and tenting with surrounding hyperintense cerebral oedema suggestive of meningioma.
Define papilledema.
Disc edema secondary to increased ICP

Where along the course of the optic nerve does ICP exert its nefarious influence?
As anterior as it can go--the posterior aspect of the lamina cribrosa

How does increased pressure at the lamina lead to edema of the optic disc?
By interfering with anterograde axoplasmic flow. (Remember, the optic nerve fibers are simply the axons of retinal ganglion cells.) Axoplasmic stasis at the lamina cribrosa leads to swelling of the fibers in the pre-laminar and NFL portion of the nerve, which in the aggregate manifests as disc edema. Fiber swelling may also compromise blood flow to the pre-laminar/NFL portions of the nerve, which could lead to further axon compromise (and therefore further swelling) as well as fluid accumulation (ditto).

Is papilledema a unilateral, or bilateral condition?
Absent pre-existing damage to one nerve, it is almost always bilateral

There is a classic syndrome which presents with unilateral papilledema--what is it?
Foster Kennedy syndrome (FKS)

What is tumor is the classic cause of FKS?
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(No question yet—keep going)

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A pt with a remote history of NAION in one eye (so that nerve is now pale and atrophic) with a recent NAION
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66-year-old vasculopathy with bilateral, sequential, acute painless vision loss from pseudo-Foster Kennedy syndrome. (A) He initially presented with acute vision loss OS and was noted to have disc edema with peripapillary hemorrhages OS from (NAION).
66-year-old vasculopathy with bilateral, sequential, acute painless vision loss from pseudo-Foster Kennedy syndrome. (A) He initially presented with acute vision loss OS and was noted to have disc edema with peripapillary hemorrhages OS from (NAION). (B) Three months later, he developed acute painless vision loss OD. Dilated fundus examination at that time showed diffuse pallor OS and hyperemic sectoral disc edema OD.
### The Optic Nerve

#### Compare and contrast acute vs chronic papilledema

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*As a practical matter, visual functioning refers to three specific exam findings. What are they?*
### The Optic Nerve

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--Visual acuity
--Visual fields
--Color vision
The Optic Nerve

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If this macular edema presents in a 'star' formation, what is the formal name for the condition, ie, for papilledema + a macular star?

It is called a neuroretinitis.

What is the classic cause of neuroretinitis?

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Neuroretinitis
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The Optic Nerve

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For more on Bartonellosis, see slide-set U25
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The Optic Nerve

Papilledema. (A) Acute; (B) Chronic
**The Optic Nerve**

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Chronic papilledema: Shunt vessels (arrow)
**The Optic Nerve**

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*Are shunt vessels ‘new,’ ie, do they represent neovascularization?*
# The Optic Nerve

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Are shunt vessels ‘new,’ *ie, do they represent neovascularization*?  
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*What are they, then?*
**The Optic Nerve**

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*Are shunt vessels ‘new,’ ie, do they represent neovascularization?*  
No

*What are they, then?*  
They are pre-existing venules that, over time, have dilated in response to chronically elevated blood flow through them.
### Compare and contrast acute vs chronic papilledema

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<tr>
<td><strong>Shunt vessels present?</strong></td>
<td>No</td>
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Are shunt vessels ‘new,’ ie, do they represent neovascularization? No

What are they, then?
They are pre-existing venules that, over time, have dilated in response to chronically elevated blood flow through them

Why are these venules subject to chronic elevations in the amount of blood they must transmit?
**The Optic Nerve**

**Compare and contrast acute vs chronic papilledema**

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*Are shunt vessels ‘new,’ ie, do they represent neovascularization?* 
No

*What are they, then?*
They are pre-existing venules that, over time, have dilated in response to chronically elevated blood flow through them

*Why are these venules subject to chronic elevations in the amount of blood they must transmit?*
Because the normal pathway of egress from the retina, ie, the central retinal vein, is partially obstructed in these eyes, and thus blood is forced to find alternate routes out of the eye.
**The Optic Nerve**

**Compare and contrast acute vs chronic papilledema**

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<td>?</td>
<td>?</td>
</tr>
<tr>
<td><strong>VF loss</strong></td>
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**The Optic Nerve**

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<td>Shunt Vessels Present</td>
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<td>Yes</td>
</tr>
<tr>
<td>Refractile Bodies Present</td>
<td>No</td>
<td>Yes</td>
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'Refractile bodies'? Do you mean optic nerve drusen?

- No, this is a completely different entity.
- OK, what are refractile bodies as seen in chronic papilledema?
  - They are minute aggregations of lipid that leached into the optic disc interstitium.
  - Where on (in?) the optic disc are they found?
    - On the surface, often near the margin.
  - Do they resolve along with resolution of the papilledema?
    - Yes.
**The Optic Nerve**

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- **Refractile bodies** present?
  - No
  - Yes

- **Shunt vessels** present?
  - No
  - Yes

- **VF loss**
  - Present
  - Absent

'Refractile bodies'? Do you mean optic nerve drusen?
No, this is a completely different entity.
The Optic Nerve

Compare and contrast acute vs chronic papilledema.

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OK, what are refractile bodies as seen in chronic papilledema?

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The Optic Nerve

Compare and contrast acute vs chronic papilledema

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No, this is a completely different entity

OK, what are refractile bodies as seen in chronic papilledema?
They are minute aggregations of lipid that leached into the optic disc interstitium

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### The Optic Nerve

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Compare and contrast acute vs chronic papilledema:

- **Visual function**: Largely intact
- **Disc appearance**: Affected
- **Disc appearance**: Hyperemic
- **Disc appearance**: Pale
- **Shunt vessels present?**: No
- **Refractile bodies present?**: No
- **VF loss**: No

**Refractile bodies**? Do you mean optic nerve drusen?
No, this is a completely different entity.

OK, what are refractile bodies as seen in chronic papilledema?
They are minute aggregations of lipid that leached into the optic disc interstitium.

Where on (in?) the optic disc are they found?
On the surface, often near the margin.

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Chronic papilledema: Refractile bodies (arrow)
The Optic Nerve

Compare and contrast acute vs chronic papilledema.

'Refractile bodies'? Do you mean optic nerve drusen?
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OK, what are refractile bodies as seen in chronic papilledema?
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Where on (in?) the optic disc are they found?
On the surface, often near the margin

Do they resolve along with resolution of the papilledema?
Yes

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<td><strong>VF loss</strong></td>
<td>None, or enlarged blind spot</td>
<td>Varies, but often extensive</td>
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