This slide encapsulates one way to think about the motility disorders. If it is unfamiliar, I strongly suggest you review the slide-set entitled ‘Motility disorders: Overview’ before proceeding. Now on with the show!
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

**What does isolated mean in this context?**

What does isolated mean in this context?

Isolated

Supranuclear

Nuclear

Infranuclear

- Fascicular
- Subarachnoid
- Cavernous sinus
- Orbital
- Neuromuscular junction
- Extraocular muscle

Supranuclear

Nuclear

Infranuclear

Internuclear

CN3 Nucleus

CN4 Nucleus

CN6 Nucleus

MLF

- Cavernous sinus
- Orbital
- Neuromuscular junction
- Extraocular muscle

Fascicular

Subarachnoid

Cavernous sinus

Orbital

Neuromuscular junction

Extraocular muscle
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

**Isolated**

Supranuclear

Nuclear

Internuclear

Infranuclear

What does **isolated** mean in this context? It means ‘absent nonocular CNS signs’
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

What does isolated mean in this context?
It means 'absent nonocular CNS signs'.

Does it also mean 'absent CNS-related pain'?
It does not. The sorts of CN3 palsies covered in this slide-set can be associated with pain.

Supranuclear

Internuclear

Nuclear

Infranuclear

Fascicular
Subarachnoid
Cavernous sinus
Orbital
Neuromuscular junction
Extraocular muscle
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

**Isolated**

What does **isolated** mean in this context?

It means ‘absent nonocular CNS signs’

**Supranuclear**

**Nuclear**

*CN3 Nucleus*

Does it also mean ‘absent CNS-related pain’?

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**Infranuclear**

- Fascicular
- Subarachnoid
- Cavernous sinus
- Orbital
- Neuromuscular junction
- Extraocular muscle
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Supranuclear

What does ‘isolated and unilateral’ imply re etiology?

Internuclear

Nuclear

CN3 Nucleus → MLF → CN6 Nucleus

Infranuclear

Fascicular
- Subarachnoid
- Cavernous sinus
- Orbital
- Neuromuscular junction
- Extraocular muscle

CN4 Nucleus
What does ‘isolated and unilateral’ imply re etiology?
It implies the lesion is infranuclear, somewhere along the path from the subarachnoid to the orbital portions.
What does ‘isolated and unilateral’ imply re etiology? It implies the lesion is infranuclear, somewhere along the path from the subarachnoid to the orbital portions.

Note: It should be mentioned (because the BCSC Neuro book mentions it) that, rarely, a brainstem lesion (ie, nuclear; fascicular) can produce an isolated unilateral CN3 palsy.
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

The majority of nontraumatic isolated third nerve palsies are secondary to what pathologic event?

Microvascular injury; ie, ischemia

In which portion of the pathway does this sort of injury occur?

The subarachnoid (although it must be noted that it could occur along the cavernous sinus portion as well)

Supranuclear

Fascicular
Subarachnoid
Cavernous sinus
Orbital
Neuromuscular junction
Extraocular muscle

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Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

**Supranuclear**

**Nuclear**

**Infranuclear**

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We'll unpack this concept in detail later in the side-set

Nontraumatic, Isolated, Unilateral CN3 Palsy

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Nontraumatic, Isolated, Unilateral CN3 Palsy

Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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- Supranuclear
- Nuclear
- Infranuclear

Fascicular
- Subarachnoid
  - Cavernous sinus
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Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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**Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy**

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**Internal**

**CN3 Nucleus**

**CN6 Nucleus**

**MLF**

**Supranuclear**

**Nuclear**

**CN4 Nucleus**

**Fascicular**

**Subarachnoid**

**Cavernous sinus**

**Orbital**

**Neuromuscular junction**

**Extraocular muscle**
Motility Disorders: **Nontraumatic, Isolated, Unilateral CN3 Palsy**

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Note that this refers to a microvascular injury that just happens to occur to the cavernous sinus portion of the nerve. It is not referring to ophthalmoparesis owing to a process intrinsic to the cavernous sinus itself!
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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(Ophthalmoparesis owing to a cavernous-sinus process is addressed in its own slide-set)
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

The way you should divvy up CN3 palsies

?  ?
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

The way you should divvy up CN3 palsies

Pupil-involving

Pupil-sparing
What does it mean to say a CN3 palsy ‘involves the pupil’? That is, what will be abnormal about the pt’s exam?

1)

2)
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

What does it mean to say a CN3 palsy ‘involves the pupil’? That is, what will be abnormal about the pt’s exam?
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Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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2) The pt will have anisocoria (one word)
Motility Disorders: *Nontraumatic, Isolated, Unilateral CN3 Palsy*

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Pupil-involving \textit{versus} Pupil-sparing

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How much larger are we talking about here?
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Well, in the context of concurrent ophthalmoparesis c/w a CN3 lesion, any enlargement is concerning. But in general, the anisocoria will be a couple of millimeters, maybe a little more.
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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What if the pupil is ‘blown,’ ie, 8+ mm? Is that even more concerning?
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The opposite, actually. A pupil that large has almost always been dilated (ie, is a so-called drug pupil).
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In addition to being larger, what else will be abnormal about the involved pupil?
It will react poorly to both [word] and [another word]
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving  versus  Pupil-sparing

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In addition to being larger, what else will be abnormal about the involved pupil? It will react poorly to both light and accommodation.
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In addition to being larger, what else will be abnormal about the involved pupil?
It will react poorly to both light and accommodation.

Which portion of the nervous system controls pupil size?

The autonomic nervous system (ANS)

The ANS has two components—what are they, and what role does each play in determining pupil size?

- Increased input from the parasympathetic fibers causes the pupil to be smaller
- Increased input from the sympathetic fibers causes the pupil to be larger
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Motility Disorders: *Nontraumatic, Isolated, Unilateral CN3 Palsy*

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- Increased input from the parasympathetic fibers causes the pupil to be smaller.
- Increased input from the sympathetic fibers causes the pupil to be larger.

Decreased
DeCREASED

Is the opposite the case—that is, does decreased parasympathetic input lead to pupil dilation, and decreased sympathetic input lead to miosis?
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving versus Pupil-sparing

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- Increased input from the parasympathetic fibers causes the pupil to be smaller
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Is the opposite the case--that is, does decreased parasympathetic input lead to pupil dilation, and decreased sympathetic input lead to miosis?

These are, in fact, the case. Remember, pupil size is based on the aggregate autonomic input. So if input from one component of the ANS decreases, the net effect of input from the other will be greater.
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving **versus** Pupil-sparing

Is it the case that the larger pupil associated with a CN3 palsy is secondary to decreased parasympathetic input to that pupil? **Yes**

The ANS has two components—what are they, and what role does each play in determining pupil size?

- Increased input from the **parasympathetic** fibers causes the pupil to be **smaller**.
- Increased input from the **sympathetic** fibers causes the pupil to be **larger**.

In addition to being larger, what else will be abnormal about the involved pupil?

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versus

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- Increased input from the sympathetic fibers causes the pupil to be larger.

Decreased input from the sympathetic fibers causes the pupil to be larger?

Yes

Decreased input from the sympathetic fibers causes the pupil to be smaller?

Yes

Is decreased sympathetic input leading to ipsilateral pupil miosis a thing?

It is indeed, as well.

What is the name for this condition?

Horner syndrome
Is the opposite the case—that is, does decreased parasympathetic input lead to pupil dilation, and decreased sympathetic input lead to miosis? These are, in fact, the case. Remember, pupil size is based on the aggregate autonomic input. So if input from one component of the ANS decreases, the net effect of input from the other will be greater.

44

Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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The ANS has two components—what are they, and what role does each play in determining pupil size?

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Is the autonomic nervous system (ANS) the one controlling pupil size?

Increased input from the parasympathetic fibers causes the pupil to be smaller; increased input from the sympathetic fibers causes the pupil to be larger.

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Yes, it is indeed, as well.

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Next we will take a side-trip to cover the sympathetic and parasympathetic pupil pathways. These are important topics, so unless you know them cold, you should probably come with…
**Sympathetic pathway:**
First-order neurons

Second-order neurons

Third-order neurons

*(No question--just get your bearings, then proceed)*
**Sympathetic pathway:**

**First-order neurons**
--Originate in hypothalamus--Travels in spinal cord--Synapses in ciliospinal center of Budge

**Second-order neurons**
--Originates at Budge center--Exits spinal cord--Travels in sympathetic chain--Synapses in superior cervical ganglion

**Third-order neurons**
--Originates in superior cervical ganglion--Travels with internal carotid artery into cavernous sinus--Hops onto VI, then V1 to enter orbit

**Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy**
Sympathetic pathway:
First-order neurons
--Originate in hypothalamus

Second-order neurons

Third-order neurons
Sympathetic pathway:
First-order neurons
--Originate in hypothalamus
--Travel in two words

Second-order neurons

Third-order neurons
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--Origin in hypothalamus
--Travel in spinal cord

Second-order neurons

Third-order neurons
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**Second-order neurons**

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Second-order neurons

Third-order neurons

Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

At what level of the spinal cord is the center of Budge found?
Sympathetic pathway:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons

Third-order neurons

Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

At what level of the spinal cord is the center of Budge found?
C8-T2
Sympathetic pathway:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons
--Originate at Budge center
--Exit

Third-order neurons
Sympathetic pathway:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons
--Originate at Budge center
--Exit spinal cord

Third-order neurons
Sympathetic pathway:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons
--Originate at Budge center
--Exit spinal cord
--Travel in spinal cord

Third-order neurons

Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy
Sympathetic pathway:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain

Third-order neurons

Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy
Sympathetic pathway:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain

Third-order neurons

Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

What major structure do these fibers pass over?

The lung apex
**Sympathetic pathway:**
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain

Third-order neurons

*What major structure do these fibers pass over?*
The lung apex

**Motility Disorders:** *Nontraumatic, Isolated, Unilateral CN3 Palsy*
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

**Sympathetic pathway:**

**First-order neurons**
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

**Second-order neurons**
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in (three words)

**Third-order neurons**
**Sympathetic pathway:**

**First-order neurons**
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

**Second-order neurons**
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion

**Third-order neurons**
Sympathetic pathway:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in **superior cervical ganglion** aka...?

Third-order neurons

*By what other name is the superior cervical ganglion known?*
**Sympathetic pathway:**
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in **superior cervical ganglion** aka...*the stellate ganglion*

Third-order neurons
*By what other name is the superior cervical ganglion known?*  
The *stellate ganglion*
Sympathetic pathway:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons *aka*...?
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion *aka*...the stellate ganglion

Third-order neurons
*By what other name is the superior cervical ganglion known?*
The stellate ganglion

*Speaking of other names...The second-order neurons are often referred to by another name, one owing to the relationship between these neurons and the ganglion to which they are headed. What is that name?*
Sympathetic pathway:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons *aka*...**pre-ganglionic neurons**
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion *aka*...**the stellate ganglion**

Third-order neurons
*By what other name is the superior cervical ganglion known?*
The **stellate ganglion**

*Speaking of other names...*The second-order neurons are often referred to by another name, one owing to the relationship between these neurons and the ganglion to which they are headed. *What is that name?***

**Pre-ganglionic** neurons
Sympathetic pathway:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons aka...pre-ganglionic neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion aka...the stellate ganglion

Third-order neurons
--Originate in superior cervical ganglion
Sympathetic pathway:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons aka...pre-ganglionic neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion aka...the stellate ganglion

Third-order neurons aka...
--Originate in superior cervical ganglion

Likewise, the third-order neurons are also referred to by a term owing to their relationship with the stellate ganglion. What is that term?
**Sympathetic pathway:**
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons *aka...pre-ganglionic neurons*
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion *aka...the stellate ganglion*

Third-order neurons *aka...post-ganglionic neurons*
--Originate in superior cervical ganglion

Likewise, the third-order neurons are also referred to by a term owing to their relationship with the stellate ganglion. What is that term? **Post-ganglionic neurons**
Sympathetic pathway:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons aka...pre-ganglionic neurons
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion aka...the stellate ganglion

Third-order neurons aka...post-ganglionic neurons
--Originate in superior cervical ganglion
--Travel with three words to enter the two words

Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy
**Sympathetic pathway:**

**First-order neurons**
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

**Second-order neurons** aka...**pre-ganglionic neurons**
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion aka...**the stellate ganglion**

**Third-order neurons** aka...**post-ganglionic neurons**
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus

**Motility Disorders:** Nontraumatic, Isolated, Unilateral CN3 Palsy
**Sympathetic pathway:**

*First-order neurons*
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

*Second-order neurons aka... pre-ganglionic neurons*
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion aka... the stellate ganglion

*Third-order neurons aka... post-ganglionic neurons*
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus
--In the sinus, hop onto cranial nerve # then cranial nerve # to enter orbit
**Sympathetic pathway:**

**First-order neurons**
- Originate in hypothalamus
- Travel in spinal cord
- Synapse in ciliospinal center of Budge

**Second-order neurons** _aka...pre-ganglionic neurons_
- Originate at Budge center
- Exit spinal cord
- Travel in sympathetic chain
- Synapse in superior cervical ganglion _aka...the stellate ganglion_

**Third-order neurons** _aka...post-ganglionic neurons_
- Originate in superior cervical ganglion
- Travel with internal carotid artery to enter the cavernous sinus
- In the sinus, hop onto cranial nerve 6, then cranial nerve V₁ to enter orbit

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**Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy**
Sympathetic pathway:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons aka...pre-ganglionic neurons
--Originate at Budge center
--Exit spinal cord

Third-order neurons aka...post-ganglionic neurons
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus
--In the sinus, hop onto cranial nerve 6, then cranial nerve V\textsubscript{1} to enter orbit

For a more detailed review of the postganglionic sympathetics pathway, see the slide-set entitled Horner syndrome
**Sympathetic pathway:**
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in ciliospinal center of Budge

Second-order neurons *aka...* **pre-ganglionic neurons**
--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain
--Synapse in superior cervical ganglion

Note that the sympathetic pre-ganglionic neurons are relatively **short** (the Budge center and stellate ganglion are very close to one another), whereas the post-ganglionic neurons are relatively **long** (they have travel the length of the ICA, then the length of the orbit). We shall see that this is not the case with the parasympathetics.

Third-order neurons *aka...* **post-ganglionic neurons**
--Originate in superior cervical ganglion
--Travel with internal carotid artery to enter the cavernous sinus
--In the sinus, hop onto cranial nerve 6, then cranial nerve V₁ to enter orbit

**Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy**
Parasympathetic pathway

And now, the parasympathetic portion of the pathway
Parasympathetic pathway:
First-order neurons?

Second-order neurons?

Third-order neurons?

Speaking of: Is the parasympathetic pathway similarly divided into 1st, 2nd and 3rd order neurons?
**Parasympathetic pathway:**

- *First-order neurons* -- Originate in hypothalamus -- Travel in spinal cord -- Synapse in ciliospinal center of Budge
- *Second-order neurons* -- Originate at Budge center -- Exit spinal cord -- Travel in sympathetic chain -- Synapse in superior cervical ganglion
- *Third-order neurons* -- Originate in superior cervical ganglion -- Travel with internal carotid artery to enter the cavernous sinus -- In the sinus, hop onto cranial nerve 6, then cranial nerve V to enter orbit

**Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy**

Speaking of: *Is the parasympathetic pathway similarly divided into 1st, 2nd and 3rd order neurons?*

No. The ‘top’ inputs that influence parasympathetic innervation of the pupil are widely distributed, and cannot reasonably be conceptualized as a unitary ‘first-order neuron.’ (Note: I made up the term ‘top inputs’ for illustrative purposes; it is not used in practice.)
**Parasympathetic pathway:**

- **First-order neurons** – ‘Top’ inputs

- **Second-order neurons**

- **Third-order neurons**

**Speaking of:** Is the parasympathetic pathway similarly divided into 1st, 2nd and 3rd order neurons? No. The ‘top’ inputs that influence parasympathetic innervation of the pupil are widely distributed, and cannot reasonably be conceptualized as a unitary ‘first-order neuron.’ (Note: I made up the term ‘top inputs’ for illustrative purposes; it is not used in practice.) It follows that if there are no 1st-order neurons, the terms second- and third-order neurons are not applicable.
Parasympathetic pathway:
- First order neurons  ‘Top’ inputs
- Second-order neurons
- Third-order neurons

Speaking of: Is the parasympathetic pathway similarly divided into 1st, 2nd and 3rd order neurons? No. The ‘top’ inputs that influence parasympathetic innervation of the pupil are widely distributed, and cannot reasonably be conceptualized as a unitary ‘first-order neuron.’ (Note: I made up the term ‘top inputs’ for illustrative purposes; it is not used in practice.) It follows that if there are no 1st-order neurons, the terms second- and third-order neurons are not applicable. For this reason, pre- and post-ganglionic are the preferred terms for these neurons.
**Parasympathetic pathway:**

- First order neurons
  - ‘Top’ inputs
  - Originate (mainly) in the **two words**

**Pre-ganglionic neurons**

**Second-order neurons**

**Post-ganglionic neurons**

**Third-order neurons**

**Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy**
**Parasympathetic pathway:**

First-order neurons  ‘Top’ inputs
--Originate (mainly) in the pretectal nuclei

Pre-ganglionic neurons
Second-order neurons

Post-ganglionic neurons
Third-order neurons
Parasympathetic pathway:
- **First order neurons**
  - ‘Top’ inputs
  - Originate (mainly) in the pretectal nuclei

**Where are the pretectal nuclei located?**
- Dorsal midbrain

**Damage to the pretectal nuclei of the dorsal midbrain produces what eponymous syndrome?**
- Parinaud syndrome (aka dorsal midbrain syndrome, aka pretectal syndrome)

**Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy**

**Nontraumatic, Isolated, Unilateral CN3 Palsy**
- Pre-ganglionic neurons
- Post-ganglionic neurons
- Second order neurons
Parasympathetic pathway:

First-order neurons  ‘Top’ inputs
--Originate (mainly) in the pretectal nuclei

Second-order neurons
--Originate at Budge center--Exit spinal cord--Travel in sympathetic chain--Synapse in superior cervical ganglion

Third-order neurons
--Originate in superior cervical ganglion--Travel with internal carotid artery to enter the cavernous sinus
--In the sinus, hop onto cranial nerve 6 , then cranial nerve V to enter orbit

Where are the pretectal nuclei located?
The dorsal midbrain

Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy
Parasympathetic pathway:

First order neurons
--Originate (mainly) in the pretectal nuclei

Second order neurons
--Originate at Budge center--Exit spinal cord--Travel in sympathetic chain-- Synapse in superior cervical ganglion

Third order neurons
--Originate in superior cervical ganglion--Travel with internal carotid artery to enter the cavernous sinus--In the sinus, hop onto cranial nerve 6, then cranial nerve V to enter orbit

Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Where are the pretectal nuclei located?
The dorsal midbrain

Damage to the pretectal nuclei of the dorsal midbrain produces what eponymous syndrome?
**Parasympathetic pathway:**

- **First-order neurons**
  - ‘Top’ inputs
  - Originate (mainly) in the pretectal nuclei
- **Second-order neurons**
  - Originate at Budge center
  - Exit spinal cord
  - Travel in sympathetic chain
  - Synapse in superior cervical ganglion
- **Third-order neurons**
  - Originate in superior cervical ganglion
  - Travel with internal carotid artery to enter the cavernous sinus
  - In the sinus, hop onto cranial nerve 6, then cranial nerve V to enter orbit

**Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy**

- **Pre-ganglionic neurons**
- **Post-ganglionic neurons**

Where are the pretectal nuclei located?
The dorsal midbrain

Damage to the pretectal nuclei of the dorsal midbrain produces what eponymous syndrome?
Parinaud syndrome (aka two words syndrome, aka syndrome)
Parasympathetic pathway:

First order neurons ---Originate (mainly) in the pretectal nuclei --Travel in spinal cord --Synapse in ciliospinal center of Budge

Second order neurons --Originate at Budge center --Exit spinal cord --Travel in sympathetic chain --Synapse in superior cervical ganglion

Third order neurons --Originate in superior cervical ganglion --Travel with internal carotid artery to enter the cavernous sinus --In the sinus, hop onto cranial nerve 6, then cranial nerve V to enter orbit

Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Where are the pretectal nuclei located?
The dorsal midbrain

Damage to the pretectal nuclei of the dorsal midbrain produces what eponymous syndrome?
Parinaud syndrome (aka dorsal midbrain syndrome, aka pretectal syndrome)
Parasympathetic pathway:

First order neurons -- 'Top' inputs
-- Originate (mainly) in the pretectal nuclei
-- Travel in spinal cord -- Synapse in ciliospinal center of Budge

Second order neurons
-- Originate at Budge center -- Exit spinal cord -- Travel in sympathetic chain -- Synapse in superior cervical ganglion

Third order neurons
-- Originate in superior cervical ganglion -- Travel with internal carotid artery to enter the cavernous sinus
-- In the sinus, hop onto cranial nerve 6, then cranial nerve V to enter orbit

Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Where are the pretectal nuclei located?
The dorsal midbrain

What are the cardinal features of Parinaud syndrome?
-- ?
-- ?
-- ?

Damage to the pretectal nuclei produces what eponymous syndrome?
Parinaud syndrome (aka dorsal midbrain syndrome, aka pretectal syndrome)
**Parasympathetic pathway:**

- **First-order neurons**
  - Originate (mainly) in the pretectal nuclei
  - Travel in the spinal cord
  - Synapse in the ciliospinal center of Budge

- **Second-order neurons**
  - Originate in the Budge center
  - Exit the spinal cord
  - Travel in the sympathetic chain
  - Synapse in the superior cervical ganglion

- **Third-order neurons**
  - Originate in the superior cervical ganglion
  - Travel with the internal carotid artery to enter the cavernous sinus
  - In the sinus, hop onto cranial nerve 6, then cranial nerve V to enter the orbit

**Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy**

**Where are the pretectal nuclei located?**

- The dorsal midbrain

**Damage to the pretectal nuclei produces what eponymous syndrome?**

- Parinaud syndrome (aka dorsal midbrain syndrome, aka pretectal syndrome)

**What are the cardinal features of Parinaud syndrome?**

- Impaired upgaze
- Lid retraction
- Convergence-retraction nystagmus
- Light-near dissociation
Parasympathetic pathway:

- First-order neurons
  - ‘Top’ inputs
  - Originate (mainly) in the pretectal nuclei
  - Travel in spinal cord
  - Synapse in ciliospinal center of Budge

- Second-order neurons
  - Originate at Budge center
  - Exit spinal cord
  - Travel in sympathetic chain
  - Synapse in superior cervical ganglion

- Third-order neurons
  - Originate in superior cervical ganglion
  - Travel with internal carotid artery to enter the cavernous sinus
  - In the sinus, hop onto cranial nerve 6, then cranial nerve V to enter orbit

Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Where are the pretectal nuclei located?
The dorsal midbrain

- Damage to the pretectal nuclei of the dorsal midbrain produces what eponymous syndrome?
- Parinaud syndrome (aka dorsal midbrain syndrome, aka pretectal syndrome)

What are the cardinal features of Parinaud syndrome?
- Impaired upgaze
- Lid retraction
- Convergence-retraction nystagmus

What is light-near dissociation?
**Parasympathetic pathway:**

First order neurons -- Originate (mainly) in the pretectal nuclei -- Travel in spinal cord -- Synapse in ciliospinal center of Budge

Second order neurons -- Originate at Budge center -- Exit spinal cord -- Travel in sympathetic chain -- Synapse in superior cervical ganglion

Third order neurons -- Originate in superior cervical ganglion -- Travel with internal carotid artery to enter the cavernous sinus -- In the sinus, hop onto cranial nerve 6, then cranial nerve V to enter orbit

**Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy**

Where are the pretectal nuclei located?
The dorsal midbrain

Damage to the pretectal nuclei produces what eponymous syndrome?
Parinaud syndrome (aka dorsal midbrain syndrome, aka pretectal syndrome)

What are the cardinal features of Parinaud syndrome?
-- Impaired upgaze
-- Lid retraction
-- Convergence retraction nystagmus

Light-near dissociation

What is light-near dissociation?
A phenomena in which pupils mioso less robustly in response to light than they do as part of the near response
**Parasympathetic pathway:**

- **First order neurons**
  - ‘Top’ inputs
  - Originate mainly in the pretectal nuclei

**Pre-ganglionic neurons**

- **Second order neurons**
  - Originate in the eponym-eponym nucleus

**Post-ganglionic neurons**

- **Third order neurons**

**Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy**
Parasympathetic pathway:

First-order neurons: ‘Top’ inputs
--Originate mainly in the pretectal nuclei

Pre-ganglionic neurons
Second-order neurons
--Originate in the Edinger-Westphal nucleus

Post-ganglionic neurons
Third-order neurons

Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy
**Parasympathetic pathway:**

First order neurons  ‘Top’ inputs
--Originate mainly in the pretectal nuclei

**Pre-ganglionic neurons**

Second order neurons
--Originate in the Edinger-Westphal nucleus

**Post-ganglionic neurons**

Third order neurons

Where in relation to the CN3 nuclear complex is the Edinger-Westphal nucleus located?

Motility Disorders: *Nontraumatic, Isolated, Unilateral CN3 Palsy*
**Parasympathetic pathway:**
- **First-order neurons** – ‘Top’ inputs
  -- Originate mainly in the pretectal nuclei

**Pre-ganglionic neurons**
- **Second-order neurons**
  -- Originate in the Edinger-Westphal nucleus

**Post-ganglionic neurons**
- **Third-order neurons**
  -- Originate in the superior cervical ganglion
  -- Travel with internal carotid artery to enter the cavernous sinus
  -- In the sinus, hop onto cranial nerve 6, then cranial nerve V to enter orbit

**Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy**

Where in relation to the CN3 nuclear complex is the Edinger-Westphal nucleus located?
It is a part of the complex
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

**Parasympathetic pathway:**
- **First-order neurons** -- 'Top' inputs
  -- Originate mainly in the pretectal nuclei

**Pre-ganglionic neurons**
- **Second-order neurons**
  -- Originate in the Edinger-Westphal nucleus
  -- Travels with CN3 into the cavernous sinus (CS)
  -- In the CS, hop onto cranial nerve 6 then cranial nerve V to enter orbit

**Post-ganglionic neurons**
- **Third-order neurons**
Parasympathetic pathway:
- First-order neurons -- ‘Top’ inputs
  -- Originate mainly in the pretectal nuclei

Pre-ganglionic neurons
- Second-order neurons
  -- Originate in the Edinger-Westphal nucleus
  -- Travels with CN3 into the cavernous sinus (CS)

Post-ganglionic neurons
- Third-order neurons
Parasympathetic pathway:
- First-order neurons: ‘Top’ inputs
  -- Originate mainly in the pretectal nuclei
- Second-order neurons
  -- Originate in the Edinger-Westphal nucleus
  -- Travel with CN3 into the cavernous sinus (CS)
- Third-order neurons
  -- Originate in the superior cervical ganglion
  -- Travel with the internal carotid artery
  -- In the sinus, hop onto cranial nerve 6, then cranial nerve V to enter the orbit

Pre-ganglionic neurons
- Second-order neurons
  -- Originate in the Edinger-Westphal nucleus
  -- Travel with CN3 into the cavernous sinus (CS)

With respect to the cross-sectional organization of CN3, in what aspect of the nerve do the pre-ganglionic fibers run?
Parasympathetic pathway:
- First-order neurons — 'Top' inputs
  -- Originate mainly in the pretectal nuclei

Pre-ganglionic neurons
- Second-order neurons
  -- Originate in the Edinger-Westphal nucleus
  -- Travels with CN3 into the cavernous sinus (CS)

With respect to the cross-sectional organization of CN3, in what aspect of the nerve do the pre-ganglionic fibers run? They run superficially, ie, on the outermost surface of the nerve
Parasympathetic pathway:
- First order neurons — ‘Top’ inputs
  -- Originate mainly in the pretectal nuclei

Pre-ganglionic neurons
- Second order neurons
  -- Originate in the Edinger-Westphal nucleus
  -- Travels with CN3 into the cavernous sinus (CS)

Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

With respect to the cross-sectional organization of CN3, in what aspect of the nerve do the pre-ganglionic fibers run?
They run superficially, ie, on the outermost surface of the nerve

Take note: This is going to be really important in a few slides!
Parasympathetic pathway:
- First order neurons -- ‘Top’ inputs
  -- Originate mainly in the pretectal nuclei

Pre-ganglionic neurons
- Second order neurons
  -- Originate in the Edinger-Westphal nucleus
  -- Travels with CN3 into the cavernous sinus (CS)

As ocular-motor nerves go, is CN3 large, or small?
**Parasympathetic pathway:**
- **First order neurons**
  - ‘Top’ inputs
  - Originate mainly in the pretectal nuclei

**Pre-ganglionic neurons**
- **Second order neurons**
  - Originate in the Edinger-Westphal nucleus
  - Travels with **CN3** into the cavernous sinus (CS)

**Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy**

*As ocular-motor nerves go, is CN3 large, or small?*
Quite large, with over 15,000 fibers (contrast that with the itty-bitty CN4 and its 2000 fibers)
Parasympathetic pathway:

First-order neurons — Originate mainly in the pretectal nuclei
  — Travel in spinal cord
  — Synapse in ciliospinal center of Budge

Second-order neurons
  — Originate in the Edinger-Westphal nucleus
  — Travels with CN3 into the cavernous sinus (CS)
  — Exit CS with inferior division of CN3
  — Synapse in ciliary ganglion

Third-order neurons
  — Originate in superior cervical ganglion
  — Travel with internal carotid artery to enter the cavernous sinus
  — In the sinus, hop onto cranial nerve 6 , then cranial nerve V

Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pre-ganglionic neurons
  — Second-order neurons
  — Originate in the Edinger-Westphal nucleus
  — Travels with CN3 into the cavernous sinus (CS)

As ocular-motor nerves go, is CN3 large, or small?
Quite large, with over 15,000 fibers (contrast that with the itty-bitty CN4 and its 2000 fibers)
Parasympathetic pathway:
- First-order neurons: ‘Top’ inputs
  - Originate mainly in the pretectal nuclei

Pre-ganglionic neurons
- Second-order neurons
  - Originate in the Edinger-Westphal nucleus
  - Travels with CN3 into the cavernous sinus (CS)

As ocular-motor nerves go, is CN3 large, or small?
Quite large, with over 15,000 fibers (contrast that with the itty-bitty CN4 and its 2000 fibers)

Take note part deaux: The fact that CN3 is a relatively large nerve will come up again as well!
Parasympathetic pathway:

- First order neurons — ‘Top’ inputs
  -- Originate mainly in the pretectal nuclei

Pre-ganglionic neurons

- Second order neurons
  -- Originate in the Edinger-Westphal nucleus
  -- Travels with CN3 into the cavernous sinus (CS)

CN3 undergoes an important conformational change while inside the CS. What is this change?

Post-ganglionic neurons

- Third order neurons
CN3 undergoes an important conformational change while inside the CS. What is this change?

It divides into two divisions: The Superior, and the Inferior

Parasympathetic pathway:
- First-order neurons — ‘Top’ inputs
- Originate mainly in the pretectal nuclei

Pre-ganglionic neurons
- Second-order neurons
- Originate in the Edinger-Westphal nucleus
- Travels with CN3 into the cavernous sinus (CS)

Post-ganglionic neurons
- Third-order neurons
- Originate in the superior cervical ganglion
- Travel with internal carotid artery to enter the cavernous sinus
- In the sinus, hop onto cranial nerve 6, then cranial nerve V to enter orbit

Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

CN3 undergoes an important conformational change while inside the CS. What is this change?

It divides into two divisions: The Superior, and the Inferior
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Parasympathetic pathway:
- First order neurons: ‘Top’ inputs
  -- Originate mainly in the pretectal nuclei

Pre-ganglionic neurons
- Second order neurons
  -- Originate in the Edinger-Westphal nucleus
  -- Travels with CN3 into the cavernous sinus (CS)

Post-ganglionic neurons
- Third order neurons

CN3 undergoes an important conformational change while inside the CS. What is this change?
It divides into two divisions: The Superior, and the Inferior
**Parasympathetic pathway:**

- **First-order neurons**
  - ‘Top’ inputs
  - Originate mainly in the pretectal nuclei

**Pre-ganglionic neurons**

- **Second-order neurons**
  - Originate in the Edinger-Westphal nucleus
  - Travels with CN3 into the cavernous sinus (CS)

**CN3 undergoes an important conformational change while inside the CS. What is this change?**

- It divides into two divisions: **The Superior**, and the **Inferior**

**Post-ganglionic neurons**

- **Third-order neurons**

Which muscles are innervated by fibers in the:

- **Superior division?**
- **Inferior division?**

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**Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy**

- **Pre-ganglionic neurons**
  - **Post-ganglionic neurons**

- ‘Top’ inputs
  - Originate mainly in the pretectal nuclei

- Travels with CN3 into the cavernous sinus (CS)

- In the sinus, hop onto cranial nerve 6, then cranial nerve V to enter orbit

- CN3 undergoes an important conformational change while inside the CS. What is this change?

- It divides into two divisions: **The Superior**, and the **Inferior**
Parasympathetic pathway:
- First-order neurons: ‘Top’ inputs
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Pre-ganglionic neurons
- Second-order neurons
  -- Originate in the Edinger-Westphal nucleus
  -- Travels with CN3 into the cavernous sinus (CS)

Post-ganglionic neurons
- Third-order neurons
  Which muscles are innervated by fibers in the:
  Superior division? Superior rectus, and the levator
  Inferior division?
Parasympathetic pathway:
- First order neurons—‘Top’ inputs
  --Originate mainly in the pretectal nuclei

Pre-ganglionic neurons
- Second order neurons
  --Originate in the Edinger-Westphal nucleus
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- Third order neurons
Which muscles are innervated by fibers in the:
Superior division? Superior rectus, and the levator
Inferior division?
**Parasympathetic pathway:**

- **First-order neurons** – 'Top' inputs
  --Originate mainly in the pretectal nuclei

- **Second-order neurons**
  --Originate in the Edinger-Westphal nucleus
  --Travels with CN3 into the cavernous sinus (CS)
  --Exits CS with inferior division of CN3
  --Synapse in the ciliary ganglion

- **Third-order neurons**
  --Originate in the superior cervical ganglion
  --Travel with the internal carotid artery to enter the cavernous sinus
  --In the sinus, hop onto cranial nerve 6, then cranial nerve V to enter the orbit

**Pre-ganglionic neurons**

- **Second-order neurons**
  --Originate in the Edinger-Westphal nucleus
  --Travels with CN3 into the cavernous sinus (CS)

*CN3 undergoes an important conformational change while inside the CS. What is this change?*

*It divides into two divisions: The Superior, and the Inferior*

**Post-ganglionic neurons**

- **Third-order neurons**

*Which muscles are innervated by fibers in the:*

Superior division? **Superior rectus, and the levator**

Inferior division? The **medial rectus, inferior rectus and inferior oblique**
Parasympathetic pathway:
- First order neurons  ‘Top’ inputs
  -- Originate mainly in the pretectal nuclei

Pre-ganglionic neurons
- Second order neurons
  -- Originate in the Edinger-Westphal nucleus
  -- Travels with CN3 into the cavernous sinus (CS)
  -- Exit CS with the inferior division of CN3

Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Post-ganglionic neurons
- Third order neurons
Parasympathetic pathway:

First-order neurons

‘Top’ inputs
--Originate mainly in the pretectal nuclei

Pre-ganglionic neurons

Second-order neurons
--Originate in the Edinger-Westphal nucleus
--Travels with CN3 into the cavernous sinus (CS)
--Exit CS with inferior division of CN3

Post-ganglionic neurons

Third-order neurons

Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy
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  - ‘Top’ inputs
  - Originate mainly in the pretectal nuclei

- **Pre-ganglionic neurons**
  - Second-order neurons
    - Originate in the Edinger-Westphal nucleus
    - Travels with CN3 into the cavernous sinus (CS)
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    - Synapse in ciliary ganglion

- **Post-ganglionic neurons**
  - Third-order neurons

**Motility Disorders:** *Nontraumatic, Isolated, Unilateral CN3 Palsy*
**Parasympathetic pathway:**

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  - Third order neurons

**Motility Disorders:** *Nontraumatic, Isolated, Unilateral CN3 Palsy*
Parasympathetic pathway:
- First order neurons: 'Top' inputs
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Pre-ganglionic neurons
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  -- Originate in the Edinger-Westphal nucleus
  -- Travels with CN3 into the cavernous sinus (CS)
  -- Exit CS with inferior division of CN3
  -- Synapse in the ciliary ganglion

Post-ganglionic neurons
- Third order neurons

Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Where is the ciliary ganglion located?
**Parasympathetic pathway:**
- First order neurons -- ‘Top’ inputs
  -- Originate mainly in the pretectal nuclei

**Pre-ganglionic neurons**
- Second order neurons
  -- Originate in the Edinger-Westphal nucleus
  -- Travels with CN3 into the cavernous sinus (CS)
  -- Exit CS with inferior division of CN3
  -- Synapse in the ciliary ganglion

**Post-ganglionic neurons**
- Third order neurons
  -- Originate in the superior cervical ganglion
  -- Travel with internal carotid artery to enter the cavernous sinus
  -- In the sinus, hop onto cranial nerve 6, then cranial nerve V to enter orbit

**Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy**
- Pre-ganglionic neurons
- Post-ganglionic neurons

*Where is the ciliary ganglion located?*
At the orbital apex
**Parasympathetic pathway:**

- **First order neurons**  
  "Top' inputs  
  --Originates mainly in the pretectal nuclei

**Pre-ganglionic neurons**

- **Second order neurons**  
  --Originate in the Edinger-Westphal nucleus  
  --Travels with CN3 until the cavernous sinus (CS)  
  --Exit CS with inferior division of CN3  
  --Synapse in ciliary ganglion

**Post-ganglionic neurons**

- **Third order neurons**  
  --Originates in ciliary ganglion
Parasympathetic pathway:
- First-order neurons: ‘Top’ inputs
  -- Originate mainly in the pretectal nuclei

Pre-ganglionic neurons
- Second-order neurons
  -- Originate in the Edinger-Westphal nucleus
  -- Travels with CN3 until the cavernous sinus (CS)
  -- Exit CS with inferior division of CN3
  -- Synapse in ciliary ganglion

Post-ganglionic neurons
- Third-order neurons
  -- Originate in ciliary ganglion
  -- Travel with nerve to the [highlighted] muscle

Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy
Parasympathetic pathway:
First-order neurons  ‘Top’ inputs
--Originate mainly in the pretectal nuclei

Pre-ganglionic neurons
Second-order neurons
--Originate in the Edinger-Westphal nucleus
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Post-ganglionic neurons
Third-order neurons
--Originate in ciliary ganglion
--Travel with nerve to the inferior oblique muscle
Parasympathetic pathway:
- First-order neurons: ‘Top’ inputs
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Pre-ganglionic neurons
- Second-order neurons
  - Originate in the Edinger-Westphal nucleus
  - Travels with CN3 until the cavernous sinus (CS)
  - Exit CS with inferior division of CN3
  - Synapse in ciliary ganglion

Post-ganglionic neurons
- Third-order neurons
  - Originate in ciliary ganglion
  - Travel with nerve to the inferior oblique muscle
  - At eye, jumps to nerves to reach the sphincter muscle
**Parasympathetic pathway:**

- **First order neurons**
  - ‘Top’ inputs
  - Originate mainly in the pretectal nuclei

- **Pre-ganglionic neurons**
  - Originate in the Edinger-Westphal nucleus
  - Travels with CN3 until the cavernous sinus (CS)
  - Exit CS with inferior division of CN3
  - Synapse in ciliary ganglion

- **Post-ganglionic neurons**
  - Originate in ciliary ganglion
  - Travel with nerve to the inferior oblique muscle
  - At eye, jumps to posterior ciliary nerves to reach the sphincter muscle

**Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy**
**Parasympathetic pathway:**
- **First order neurons** — ‘Top’ inputs
  -- Originate mainly in the pretectal nuclei

**Pre-ganglionic neurons**
Note that the relative lengths of the pre- and post-ganglionic parasympathetic neurons are opposite of what they were for the sympathetics. Their pre-ganglionic fibers are relatively long, wending their way out to ganglia located near the end-organs they innervate. (Recall that sympathetic ganglia are all axial-CNS-adjacent.) From these far-flung ganglia, it is just a hop, skip and jump for the post-ganglionics to reach their targets.

**Post-ganglionic neurons**
- **Third order neurons**
  -- Originate in ciliary ganglion
  -- Travel with nerve to the inferior oblique muscle
  -- At eye, jumps to posterior ciliary nerves to reach the sphincter muscle

**Motility Disorders:** *Nontraumatic, Isolated, Unilateral CN3 Palsy*
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving \[versus\] Pupil-sparing

OK, side-trip over. Now let’s use what we’ve learned to better understand the pathophysiology of CN3 palsy
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving  \textit{versus}  Pupil-sparing

\textit{Why is pupil involvement the key issue regarding CN3 palsies?}
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Why is pupil involvement the key issue regarding CN3 palsies?
Because of its implications regarding the underlying cause of the palsy
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Why is pupil involvement the key issue regarding CN3 palsies?
Because of its implications regarding the underlying cause of the palsy

Which potential cause of CN3 palsy in particular are we concerned about?
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Why is pupil involvement the key issue regarding CN3 palsies?
Because of its implications regarding the underlying cause of the palsy.

Which potential cause of CN3 palsy in particular are we concerned about?
Compression of the nerve by an aneurysm of the posterior communicating artery.
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Why is pupil involvement the key issue regarding CN3 palsies?
Because of its implications regarding the underlying cause of the palsy

Which potential cause of CN3 palsy in particular are we concerned about?
Compression of the nerve by an aneurysm of the posterior communicating artery
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Why is pupil involvement the key issue regarding CN3 palsies?
Because of its implications regarding the underlying cause of the palsy

Which potential cause of CN3 palsy in particular are we concerned about?
Compression of the nerve by an aneurysm of the posterior communicating artery

(More specifically, the aneurysm usually is located at the junction of the PComm and internal-carotid arteries)
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Why is pupil involvement the key issue regarding CN3 palsies? Because of its implications regarding the underlying cause of the palsy.

Which potential cause of CN3 palsy in particular are we concerned about? Compression of the nerve by an aneurysm of the posterior communicating artery.

Why should we be concerned about a PComm aneurysm?
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

**Pupil-involving** *versus* **Pupil-sparing**

*Why is pupil involvement the key issue regarding CN3 palsies?*
Because of its implications regarding the underlying cause of the palsy.

*Which potential cause of CN3 palsy in particular are we concerned about?*
Compression of the nerve by an aneurysm of the posterior communicating artery.

*Why should we be concerned about a PComm aneurysm?*
Because it is a potentially lethal condition, and its proper and timely dx may well save the pt’s life.
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving \textit{versus} Pupil-sparing

Why is pupil involvement the key issue regarding CN3 palsies? Because of its implications regarding the underlying cause of the palsy.

How is it that the status of the pupil implicates a compressive lesion as causing a CN3 palsy?
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Why is pupil involvement the key issue regarding CN3 palsies?
Because of its implications regarding the underlying cause of the palsy.

How is it that the status of the pupil implicates a compressive lesion as causing a CN3 palsy?
It has everything to do with the topography of the third nerve. Recall that the pre-ganglionic parasymptathetics run in the superficial, outermost portion of the nerve.
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Why is pupil involvement the key issue regarding CN3 palsies?
Because of its implications regarding the underlying cause of the palsy

Why should we be concerned about a PComm aneurysm?
Because it is a potentially lethal condition, and its proper and timely dx may well save the pt's life

How is it that the status of the pupil implicates a compressive lesion as causing a CN3 palsy?
It has everything to do with the topography of the third nerve. Recall that the pre-ganglionic parasympathetics run in the superficial, outermost portion of the nerve. Given this, it stands to reason that a lesion compressing the nerve will bag these fibers, leaving the sympathetics unopposed to dilate the pupil on that side.
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving

Pupil-sparing

Getting down to clinical brass tacks: A pt presents with an apparent pupil-involving CN3 palsy. How should you approach this situation?
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving

Getting down to clinical brass tacks: A pt presents with an apparent pupil-involving CN3 palsy. How should you approach this situation? Thusly: With two exceptions, a pupil-involving CN3 palsy is assumed to represent a Pcomm aneurysm until proven otherwise.

Pupil-sparing
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving

Getting down to clinical brass tacks: A pt presents with an apparent pupil-involving CN3 palsy. How should you approach this situation? Thusly: **With two exceptions**, a pupil-involving CN3 palsy is assumed to represent a Pcomm aneurysm until proven otherwise.

What are the two exceptions?

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-
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Getting down to clinical brass tacks: A pt presents with an apparent pupil-involving CN3 palsy. How should you approach this situation? Thusly: **With two exceptions**, a pupil-involving CN3 palsy is assumed to represent a Pcomm aneurysm until proven otherwise.

**What are the two exceptions?**
--If there is an appropriate trauma hx
--If the pupil finding is isolated, ie, if EOM function is intact (because the probability of an aneurysm in this scenario is essentially zero)
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving

Pupil-sparing

Getting down to clinical brass tacks: A pt presents with an apparent pupil-involving CN3 palsy. How should you approach this situation? Thusly: With two exceptions, a pupil-involving CN3 palsy is assumed to represent a Pcomm aneurysm until proven otherwise.

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--If there is an appropriate trauma hx
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What does appropriate mean in this context?

---If there is an appropriate trauma hx
---If the pupil finding is isolated, ie, if EOM function is intact (because the probability of an aneurysm in this scenario is essentially zero)
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Getting down to clinical brass tacks: A pt presents with an apparent pupil-involving CN3 palsy. How should you approach this situation? Thusly: **With two exceptions**, a pupil-involving CN3 palsy is assumed to represent a Pcomm aneurysm until proven otherwise.

**What are the two exceptions?**
- If there is an *appropriate* trauma hx
- If the pupil finding is isolated, i.e., if EOM function is intact (because the probability of an aneurysm in this scenario is essentially zero)

**What does appropriate mean in this context?**
It means 1) the temporal relationship between the trauma and the onset of the palsy make sense, and 2) the trauma must have been severe enough to plausibly produce a CN3 palsy.
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Getting down to clinical brass tacks: A pt presents with an apparent pupil-involving CN3 palsy. How should you approach this situation?

Thusly: With two exceptions, a pupil-involving CN3 palsy is assumed to represent a Pcomm aneurysm until proven otherwise.

A patient presents with an enlarged pupil. Her motility is full to finger-following. Is it OK to send this patient home?

No! In the setting of a possible CN3 palsy, finger-following is an inadequate test for ruling out EOM involvement. To truly rule out a partial/subtle external CN3 palsy, cover testing must be performed!

OK, OK, calm down. I did standard cover-testing, and everything seemed fine. Can I please let the pt go now?

No! Like finger-following, primary-gaze cover testing is inadequate for ruling out a CN3 palsy, which can be very subtle.

Sigh. OK then, how should cover testing be performed?

Cover testing should be performed while the pt is 'face turned' so as to place the eye in the fields of gaze in which a CN3 palsy would manifest; ie, in down-, up- and medial gaze. If a subtle palsy is present, putting the eye into the fields of action of the CN3-controlled EOMs will bring it out.

Only testing performed in this manner is considered adequate to rule out EOM involvement in a pupil-involving CN3 palsy!

What are the two exceptions?
--If there is an appropriate trauma hx
--If the pupil finding is isolated, ie, if the probability of an aneurysm in this scenario is essentially zero
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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Pupil-involving

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Pupil-sparing

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Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving

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Pupil-sparing
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving

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Pupil-sparing
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving

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Sigh. OK then, how should cover testing be performed? Cover testing should be performed while the pt is ‘face turned’ so as to place the eye in the fields of gaze in which a CN3 palsy would manifest; ie, in down-, up- and medial gaze. If a subtle palsy is present, putting the eye into the fields of action of the CN3-controlled EOMs will bring it out. Only testing performed in this manner is considered adequate to rule out EOM involvement in a pupil-involving CN3 palsy!

Pupil-sparing
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving

Getting down to clinical brass tacks: A pt presents with an apparent pupil-involving CN3 palsy. How should you approach this situation? Thusly: With two exceptions, a pupil-involving CN3 palsy is assumed to represent a Pcomm aneurysm until proven otherwise.

What are the two exceptions?
-- If there is an appropriate trauma hx
-- If the pupil finding is isolated, ie, if EOM function is intact (because the probability of an aneurysm in this scenario is essentially zero)

What are the three likely causes of an isolated dilated pupil?
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Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Getting down to clinical brass tacks: A pt presents with an apparent pupil-involving CN3 palsy. How should you approach this situation? Thusly: **With two exceptions**, a pupil-involving CN3 palsy is assumed to represent a Pcomm aneurysm until proven otherwise.

**What are the two exceptions?**
--If there is an appropriate trauma hx
--If the pupil finding is isolated, ie, if EOM function is intact (because the probability of an aneurysm in this scenario is essentially zero)

**What are the three likely causes of an isolated dilated pupil?**
--Pharmacologic dilation
--Adie’s tonic pupil
--Local iris damage (eg, posterior synechiae; post-surgical)
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving

Getting down to clinical brass tacks: A pt presents with an apparent pupil-involving CN3 palsy. How should you approach this situation? Thusly: With two exceptions, a pupil-involving CN3 palsy is assumed to represent a Pcomm aneurysm until proven otherwise.

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--If the pupil finding is isolated, ie, if EOM function is intact (because the probability of an aneurysm in this scenario is essentially zero)

What are the three likely causes of an isolated dilated pupil?
--Pharmacologic dilation
--Adie’s tonic pupil (Adie’s tonic pupil is addressed at length in the slide-set entitled Anisocoria)
--Local iris damage (eg, posterior synechiae, post-surgical)
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Getting down to clinical brass tacks: A pt presents with a pupil-involving CN3 palsy. How should you approach this situation?
Thusly: With two exceptions, a pupil-involving CN3 palsy is assumed to represent a Pcomm aneurysm until proven otherwise

Further brass tacks: How should a pupil-involving CN3 palsy be handled?
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Getting down to clinical brass tacks: A pt presents with a pupil-involving CN3 palsy. How should you approach this situation?
Thusly: With two exceptions, a pupil-involving CN3 palsy is assumed to represent a Pcomm aneurysm until proven otherwise

Further brass tacks: How should a pupil-involving CN3 palsy be handled?
Emergent imaging of the CNS vasculature must be performed to rule out a Pcomm aneurysm
Motility Disorders: *Nontraumatic, Isolated, Unilateral CN3 Palsy*

**Pupil-involving**

**Pupil-sparing**

Getting down to clinical brass tacks: A pt presents with a pupil-involving CN3 palsy. How should you approach this situation?

Thusly: With two exceptions, a pupil-involving CN3 palsy is assumed to represent a Pcomm aneurysm until proven otherwise.

Further brass tacks: How should a pupil-involving CN3 palsy be handled?
Emergent [imaging of the CNS vasculature](#) must be performed to rule out a Pcomm aneurysm.

What three *imaging modalities are appropriate/available for detecting a Pcomm aneurysm*?

- --
- --
- --
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving

Getting down to clinical brass tacks: A pt presents with a pupil-involving CN3 palsy. How should you approach this situation?
Thusly: With two exceptions, a pupil-involving CN3 palsy is assumed to represent a Pcomm aneurysm until proven otherwise

Further brass tacks: How should a pupil-involving CN3 palsy be handled?
Emergent imaging of the CNS vasculature must be performed to rule out a Pcomm aneurysm

What three imaging modalities are appropriate/available for detecting a Pcomm aneurysm?
--CT angiography (CTA)
--MR angiography (MRA)
--Catheter angiography

Pupil-sparing
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving

Pupil-sparing

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Which is best?
Motility Disorders: *Nontraumatic, Isolated, Unilateral CN3 Palsy*

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**Pupil-sparing**

Further brass tacks: How should a pupil-involving CN3 palsy be handled? Emergent *imaging of the CNS vasculature* must be performed to rule out a Pcomm aneurysm.

*What three imaging modalities are appropriate/available for detecting a Pcomm aneurysm?*  
--CT angiography (CTA)  
--MR angiography (MRA)  
--Catheter angiography

*Which is best?*  
Each has advantages and disadvantages; selection should be done in consultation with one's local neuro-radiologist (although it should be said that the convenience and safety of CTA and MRA have rendered catheter angiography a distant third choice for diagnostic imaging).
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving

Pupil-sparing

What does it mean to say a CN3 palsy is pupil-sparing?
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving

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Pretty much what it sounds like—EOM deficiencies consistent with a CN3 distribution are present, but there is no anisocoria, and pupil motor function is intact.
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The majority of nontraumatic isolated third nerve palsies are secondary to what pathologic event?
Microvascular injury; ie, ischemia

In which portion of the pathway does this sort of injury occur?
The subarachnoid (although it must be noted that it could occur along the cavernous sinus portion as well)
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What is the name for blood vessels that service the inner aspect of a nerve?

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Vasa nervora

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As with compressive lesions, it’s all about CN3 anatomy. Recall that CN3 is a large-diameter nerve. Because of its size, it is highly vascularized and cannot be compressed to the extent that a smaller nerve can. The nerve’s pre-ganglionic parasympathetics run in the superficial, outermost portion of the nerve. In this location, they are oxygenated not by perforating vasa nervora vessels, but rather via the vast web of pial vessels that surround the nerve.

Given this, it stands to reason that an ischemic insult to the inner portion of the nerve will not bag the parasympathetic fibers, thereby leaving parasympathetic input to the pupil intact. Thus, the pupil will be of normal size and reactivity—no anisocoria, no ‘motor pupil.’

How can the status of the pupil implicate ischemia as causing a CN3 palsy?

Yet again, look to the nerve’s topography for the explanation. Recall that the pre-ganglionic parasympathetics run in the superficial, outermost portion of the nerve. In this location, they are oxygenated not by perforating vasa nervora vessels, but rather via the vast web of pial vessels that surround the nerve.

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No. Per the BCSC Neuro book, 20% of vascular thirds are pupil-involving.

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In a vascular, pupil-involving CN3 palsy, does the amount of anisocoria tend to be small, or large?

- It is almost always small (usually less than 1mm)
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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Pupil-involving

Pupil-sparing

With regard to management, pupil-sparing nontraumatic isolated CN3 palsies are divided into two categories. What are they?
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Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involved

Pupil-sparing

Complete versus Partial

What is meant by referring to a pupil-sparing CN3 palsy as ‘complete’ vs ‘partial’?
It refers to the status of the external muscles controlled by CN3. If they are all involved, the palsy is complete; if they are not, it is partial.
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Why is the degree of involvement important?
Because of its clinical implications. A complete pupil-sparing CN3 palsy is virtually a lock to be vascular if the following pt-related conditions are met:
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Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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--the pt is over ; and
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Pupil-involving

Pupil-sparing

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--The pt is a vasculopath;
--the pt is over 50; and
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Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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OK, so a vasculopathic, cancer-free, 50+ pt has a complete pupil-sparing CN3 palsy. Does this carry significant implications for management?
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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OK, so a vasculopathic, cancer-free, 50+ pt has a complete pupil-sparing CN3 palsy. Does this carry significant implications for management?
It does, in that it means the pt need not undergo emergent imaging to r/o an aneurysm
Motility Disorders: *Nontraumatic, Isolated, Unilateral CN3 Palsy*

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Does this mean you can cut the pt loose, telling her to come back when she needs cataract surgery? Emergency imaging to rule out an aneurysm...
Motility Disorders: *Nontraumatic, Isolated, Unilateral CN3 Palsy*

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Does this mean you can cut the pt loose, telling her to come back when she needs cataract surgery?

No, such pts must be followed closely, and a general medical eval should be considered.

For emergent imaging to rule out an aneurysm.
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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- the pt is over 50;
- the pt has no hx of cancer

What should this ‘general medical eval’ consist of?

- Consider checking inflammatory markers (eg, ESR)

No! such pts must be followed closely, and a general medical eval should be considered to come back when she needs cataract surgery?
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What should this ‘general medical eval’ consist of?
- BP assessment
- Check blood glucose status (A1c, etc)
- Fasting lipid panel
- Consider checking inflammatory markers (eg, ESR)

No! Such pts must be followed closely, and a general medical eval should be considered.
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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Does this mean you can cut the pt loose, telling her to come back when she needs cataract surgery? **Not such pts must be followed**

While following the pt, what are you on the lookout for?
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Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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Does this mean you can cut the pt loose, telling her to come back when she needs cataract surgery? No! such pts must be followed closely, and a general medical eval should be considered.

While following the pt, what are you on the lookout for?
--The onset of pupil involvement; or
--The development of signs/symptoms involving other cranial nerves; or
--Failure of the palsy to resolve by amount of time
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving

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While following the pt, what are you on the lookout for?
--The onset of pupil involvement; or
--The development of signs/symptoms involving other cranial nerves; or
--Failure of the palsy to resolve by 3 months
Motility Disorders: *Nontraumatic, Isolated, Unilateral CN3 Palsy*

Pupil-involving

Pupil-sparing

**Complete**

**Partial**

What is meant by referring to a pupil-sparing CN3 palsy as ‘complete’ vs ‘partial’?

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While following the pt, what are you on the lookout for?

--The onset of pupil involvement; or
--The development of signs/symptoms involving other cranial nerves; or
--Failure of the palsy to resolve by 3 months

What should be done if any of these things come to pass?

Imaging should be pursued.
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving

Pupil-sparing

Complete versus Partial

What is meant by referring to a pupil-sparing CN3 palsy as ‘complete’ vs ‘partial’?
It refers to the status of the external muscles controlled by CN3. If they are all involved, the palsy is complete; if they are not, it is partial.

Why is the degree of involvement important?
Because of its clinical implications. A complete pupil-sparing CN3 palsy is virtually a lock to be vascular if the following pt-related conditions are met:
- The pt is a vasculopath;
- the pt is over 50; and
- the pt has no hx of cancer

Does this mean you can cut the pt loose, telling her to come back when she needs cataract surgery?
Not such pts must be followed closely, and a general medical eval should be considered.

While following the pt, what are you on the lookout for?
--The onset of pupil involvement; or
--The development of signs/symptoms involving other cranial nerves; or
--Failure of the palsy to resolve by 3 months

What should be done if any of these things come to pass?
Imaging should be pursued.
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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Dat Pcomm aneurysm

A malignancy

Malignancy
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving

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versus

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--The onset of pupil involvement; or
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--Failure of the palsy to resolve by 3 months.

Imaging should be pursued if any of these things come to pass.

Anisocoria develops? Dat Pcomm aneurysm.

What are you looking for on imaging if…...?
Motility Disorders: *Nontraumatic, Isolated, Unilateral CN3 Palsy*

**Pupil-involving**

**Pupil-sparing**

---

**Complete** vs **Partial**

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OK, so a vasculopathic, cancer-free, 50+ pt has a complete pupil-sparing CN3 palsy. Does this carry significant implications for management? It does, in that it means the pt need not undergo emergent imaging to r/o an aneurysm. Does this mean you can cut the pt loose, telling her to come back when she needs cataract surgery? No! Such pts must be followed closely, and a general medical eval should be considered.

While following the pt, what are you on the lookout for?

--The onset of pupil involvement;
--The development of signs/symptoms involving other cranial nerves; or
--Failure of the palsy to resolve by 3 months.

What should be done if any of these things come to pass? Imaging should be pursued.

---

**What are you looking for on imaging if…**

---*anisocoria develops?* Dat Pcomm aneurysm
---*other S/S develop?* Malignancy
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving

Pupil-sparing

Complete

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What are you looking for on imaging if...
...anisocoria develops? Dat Pcomm aneurysm
...other S/S develop? A malignancy

Does this mean you can cut the pt loose, telling her to come back when she needs cataract surgery?
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--The development of signs/symptoms involving other cranial nerves; or
--Failure of the palsy to resolve by 3 months

What should be done if any of these things come to pass?
Imaging should be pursued

What are you looking for on imaging if...
...anisocoria develops? Dat Pcomm aneurysm
...other S/S develop? A malignancy
...the palsy fails to resolve by month 3?
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving

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What should be done if any of these things come to pass?
Imaging should be pursued

What are you looking for on imaging if...
...anisocoria develops? Dat Pcomm aneurysm
...other S/S develop? A malignancy
...the palsy fails to resolve by month 3? Malignancy
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--The onset of pupil involvement; or
--The development of signs/symptoms involving other cranial nerves; or
--Failure of the palsy to resolve by 3 months

What should be done if any of these things come to pass?

Imaging should be pursued

At what location might one expect a malignancy to be found?

--
--

What are you looking for on imaging if...

...anisocoria develops?

A dural shunt aneurysm

...other S/S develop?

A malignancy

...the palsy fails to resolve by month 3?

Malignancy

At what location might one expect a malignancy to be found?
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving

Pupil-sparing

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--The pt is a vasculopath;
--the pt is over 50; and
--the pt has no hx of cancer.

At what location might one expect a malignancy to be found?
--The skull base
--The cavernous sinus

What are you looking for on imaging if...
--anisocoria develops?
A Dat Pcomm aneurysm
--other S/S develop?
A malignancy
--the palsy fails to resolve by month 3?
Malignancy

Where might one expect a malignancy to be found?
--The skull base
--The cavernous sinus

OK, so a vasculopathic, cancer-free, 50+ pt has a complete pupil-sparing CN3 palsy. Does this carry significant implications for management?
It does, in that it means the pt need not undergo emergent imaging to rule out an aneurysm.

Does this mean you can cut the pt loose, telling her to come back when she needs cataract surgery?
No! Such pts must be followed closely, and a general medical eval should be considered.

While following the pt, what are you on the lookout for?
--The onset of pupil involvement; or
--The development of signs/symptoms involving other cranial nerves; or
--Failure of the palsy to resolve by 3 months

What should be done if any of these things come to pass?
Imaging should be pursued.
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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Why is the degree of involvement important?

Because of its clinical implications. A complete pupil-sparing CN3 palsy is virtually a lock to be vascular if the following pt-related conditions are met:

--The pt is a vasculopath;
--the pt is over 50; and
--the pt has no hx of cancer.

So a pt has a partial pupil-sparing CN3 palsy.

What implications does this carry for etiology?
Motility Disorders: *Nontraumatic, Isolated, Unilateral CN3 Palsy*

Pupil-involving

Pupil-sparing

- Complete
- Partial

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- The pt is a vasculopath;
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So a pt has a **partial** pupil-sparing CN3 palsy.

What implications does this carry for etiology?
It is much more concerning for a compressive lesion than is a complete pupil-sparing third
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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So a pt has a partial pupil-sparing CN3 palsy.
What implications does this carry for etiology?
It is much more concerning for a compressive lesion than is a complete pupil-sparing third

How should such pts be managed?
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving

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--the pt is over 50; and
--the pt has no hx of cancer.

So a pt has a partial pupil-sparing CN3 palsy. What implications does this carry for etiology? It is much more concerning for a compressive lesion than is a complete pupil-sparing third.

How should such pts be managed? They should be imaged immediately.
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

And finally, three related topics:

Topic 1: CN3 palsies in kids. How should they be managed? If pupil-sparing, they can be followed; if pupil-involving, they must be imaged.

Topic 2: Pain. Can etiology (ie, compressive vs ischemic) be differentiated on the basis of whether pain is present? No. While it is the case that most aneurysmal thirds are painful and most vascular are painless, exceptions are frequent enough that pain-status cannot reliably differentiate between them.

Topic 3: Aberrant regeneration. What the heck is it? A phenomenon in which healing nerve fibers form incorrect connections, resulting in impulses intended for one muscle stimulating a different one.
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

And finally, three related topics:

**Topic 1: CN3 palsies in kids.** *How should they be managed?*
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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If pupil-sparing, they can be followed; if pupil-involving, they must be imaged
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**Topic 1: CN3 palsies in kids.** *How should they be managed?*
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**Are Pcomm aneurysms common in kids?**
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

And finally, three related topics:

**Topic 1: CN3 palsies in kids.** *How should they be managed?*
If pupil-sparing, they can be followed; **if pupil-involving, they must be imaged**

*Are Pcomm aneurysms common in kids?*
No, they are very rare
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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**Topic 1: CN3 palsies in kids.** *How should they be managed?*
If pupil-sparing, they can be followed; **if pupil-involving, they must be imaged**

- *Are Pcomm aneurysms common in kids?*
  No, they are very rare

- *What are common causes on CN3 palsy in kids?*
And finally, three related topics:

**Topic 1: CN3 palsies in kids. How should they be managed?**
If pupil-sparing, they can be followed; **if pupil-involving, they must be imaged**

*Are Pcomm aneurysms common in kids?*
No, they are very rare

*What are common causes on CN3 palsy in kids?*
Post-viral or -vaccinal syndromes
And finally, three related topics:

**Topic 1: CN3 palsies in kids.** *How should they be managed?*
If pupil-sparing, they can be followed; if pupil-involving, they must be imaged

**Topic 2: Pain.** *Can etiology (ie, compressive vs ischemic) be differentiated on the basis of whether pain is present?*
And finally, three related topics:

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Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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**Topic 3: Aberrant regeneration.** *What the heck is it?*
A phenomenon in which healing nerve fibers form incorrect connections, resulting in impulses intended for one muscle stimulating a different one

What are the classic aberrant regeneration mis-connections?
-- Attempted adduction
-- Attempted globe adduction, elevation or depression
And finally, three related topics:

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*What are the classic aberrant regeneration mis-connections?*

--Attempted adduction $\rightarrow$ eyelid retraction

--Attempted globe adduction, elevation or depression $\rightarrow$
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

And finally, three related topics:

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**Topic 3: Aberrant regeneration.** *What the heck is it?* A phenomenon in which healing nerve fibers form incorrect connections, resulting in impulses intended for one muscle stimulating a different one.

*Of the three main causes of isolated unilateral CN3 palsy (ie, traumatic, compressive and ischemic), which is/are capable of resulting in aberrant regeneration?*
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

And finally, three related topics:

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*Of the three main causes of isolated unilateral CN3 palsy (ie, traumatic, compressive and ischemic), which is/are capable of resulting in aberrant regeneration?* Both _traumatic_ and _compressive_ can; on the other hand, _ischemic_ never does.
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

And finally, three related topics:

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3. Topic 3: Aberrant regeneration. What the heck is it? A phenomenon in which healing nerve fibers form incorrect connections, resulting in impulses intended for one muscle stimulating a different one.

In this context, to what does the term primary aberrant regeneration refer? It refers to the presence of aberrant-regeneration-type EOM movements absent a clear history of a precipitating CN3 palsy. What etiology is suggested by this presentation? A slowly-expanding compressive lesion in the parasellar region. How should one manage a pt with primary aberrant regeneration? Via imaging with special attention to the parasellar region (looking for a meningioma) and cavernous sinus (looking for an aneurysm of the internal carotid).
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

And finally, three related topics:

In this context, to what does the term primary aberrant regeneration refer? It refers to the presence of aberrant-regeneration-type EOM movements absent a clear history of a precipitating CN3 palsy.

Primary

Topic 3: Aberrant regeneration. What the heck is it? A phenomenon in which healing nerve fibers form incorrect connections, resulting in impulses intended for one muscle stimulating a different one.

In this context, to what does the term primary aberrant regeneration refer?
It refers to the presence of aberrant-regeneration-type EOM movements absent a clear history of a precipitating CN3 palsy.
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

And finally, three related topics:

In this context, to what does the term primary aberrant regeneration refer?
It refers to the presence of aberrant-regeneration-type EOM movements absent a clear history of a precipitating CN3 palsy

What etiology is suggested by this presentation?

Primary aberrant regeneration. What the heck is it?
A phenomenon in which healing nerve fibers form incorrect connections, resulting in impulses intended for one muscle stimulating a different one...
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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Motility Disorders: *Nontraumatic, Isolated, Unilateral CN3 Palsy*

And finally, three related topics:

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A slowly-expanding compressive lesion in the parasellar region

*How should one manage a pt with primary aberrant regeneration?*

**Topic 3: Aberrant regeneration. What the heck is it?**
A phenomenon in which healing nerve fibers form incorrect connections, resulting in impulses intended for one muscle stimulating a different one
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1. **Topic 1: CN3 palsies in kids.** How should they be managed? If pupil-sparing, they can be followed; if pupil-involving, they must be imaged.

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**In this context, to what does the term primary aberrant regeneration refer?**
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**What etiology is suggested by this presentation?**
A slowly-expanding compressive lesion in the parasellar region.

**How should one manage a pt with primary aberrant regeneration?**
Via imaging with special attention to the parasellar region (looking for a meningioma) and cavernous sinus (looking for an aneurysm of the internal carotid).
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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Via imaging with special attention to the parasellar region (looking for a meningioma) and cavernous sinus (looking for an aneurysm of the internal carotid).

Topic 3: Aberrant regeneration. What the heck is it?
A phenomenon in which healing nerve fibers form incorrect connections, resulting in impulses intended for one muscle stimulating a different one.