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?

Supranuclear

Internuclear

Nuclear

Infranuclear

MLF

CN3 Nucleus

CN6 Nucleus

CN4 Nucleus

Fascicular

Subarachnoid

Cavernous sinus

Orbital

Neuromuscular junction

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

What does isolated mean in this context?
It means ‘absent nonocular CNS signs’

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Nontraumatic, Isolated, Unilateral CN3 Palsy

Motility Disorders: 

- **Supranuclear**
- **Nuclear**
- **Infranuclear**

What does **isolated** mean in this context? It means ‘absent nonocular CNS signs’

Does it also mean ‘absent CNS-related pain’? No, it does not. The sorts of CN3 palsies covered in this slide-set can be associated with pain.
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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Supranuclear

Nuclear

Infranuclear

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

Supranuclear

What does ‘isolated and unilateral’ imply re etiology?

Internuclear

Nuclear

CN3 Nucleus

MLF

CN6 Nucleus

CN4 Nucleus

Infranuclear

Fascicular
Subarachnoid
Cavernous sinus
Orbital
Neuromuscular junction
Extraocular muscle
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 (i.e., nuclear; fascicular) can produce an isolated unilateral CN3 palsy.
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

**Supranuclear**

**Nuclear**

**Infranuclear**

- Fascicular
  - Subarachnoid
  - Cavernous sinus
  - Orbital
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The majority of nontraumatic isolated third nerve palsies are secondary to what pathologic event?

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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?

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

MLF

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

Supranuclear

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Internuclear

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Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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Microvascular injury; ie, ischemia

We’ll unpack this concept in detail later in the side-set.
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Supranuclear

Nuclear

Internuclear

Infranuclear

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

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Nuclear

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Fascicular?

Subarachnoid

Cavernous sinus?

Orbital?

Neuromuscular junction?

Extraocular muscle?

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

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

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1) The pt will have unilateral ophthalmoparesis in a pattern consistent with innervation by CN3; and

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Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving \textit{versus} Pupil-sparing

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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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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.
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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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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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Which portion of the nervous system controls pupil size?
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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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--Increased input from the other fibers causes the pupil to be larger.
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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?
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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

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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.

Indeed it is.

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

lager? Yes

smaller? Yes

Decreased

Decreased

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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

Is the difference in pupil size due to decreased sympathetics leading to miosis?

Yes

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

Yes
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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Is the autonomic nervous system (ANS) the part of the nervous system that controls pupil size? 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.

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

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

It is indeed, as well.

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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.
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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

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
structure

Second-order neurons

Third-order neurons

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 ...

Second-order neurons

Third-order neurons
Sympathetic pathway:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord

Second-order neurons

Third-order neurons
**Sympathetic pathway:**

**First-order neurons**
--Originate in hypothalamus
--Travel in spinal cord
--Synapse in

**Second-order neurons**

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

Second-order neurons

Third-order neurons

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

At what level of the spinal cord is the center of Budge found?
C8-T2

Third-order neurons

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

**Second-order neurons**
--Origin 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 sympathetic chain

**Third-order neurons**

**Motility Disorders:** *Nontraumatic, Isolated, Unilateral CN3 Palsy*
Sympathetic pathway:
First-order neurons
--Originate in hypothalamus
--Travel in spinal cord
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--Originate at Budge center
--Exit spinal cord
--Travel in sympathetic chain

Third-order neurons
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First-order neurons
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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?

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

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
--Synapse in three words

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

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

Second-order neurons
--Origin 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
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...?
--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
**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
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

**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 V₁ 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
Parasympathetic pathway:
First-order neurons?

Second-order neurons?

Third-order neurons?

Speaking of: Is the parasympathetic pathway similarly divided into 1\textsuperscript{st}, 2\textsuperscript{nd} and 3\textsuperscript{rd} order neurons?
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.)
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

Pre-ganglionic neurons
- Second order neurons

Post-ganglionic neurons
- Third order neurons

Speaking of: Is the parasympathetic pathway similarly divided into 1\textsuperscript{st}, 2\textsuperscript{nd} and 3\textsuperscript{rd} 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 1\textsuperscript{st}-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

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

**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**
- 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?**

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

Parasympathetic pathway:

Where are the pretectal nuclei located?
The dorsal midbrain

Pre-ganglionic neurons

Second order neurons

Post-ganglionic neurons

Third order neurons

‘Top’ inputs

pretectal nuclei
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

Damage to the pretectal nuclei of the dorsal midbrain produces what eponymous 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 two words syndrome, aka syndrome)
Parasympathetic pathway:
First order neurons:
--Originate (mainly) in the pretectal nuclei

‘Top’ inputs

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**

- Pre-ganglionic neurons
- Post-ganglionic neurons

**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?**
- ?
- ?
- ?
- ?
**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 eponym?

**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
- **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 produces what 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?**
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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

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 miose 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

Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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

Post-ganglionic neurons
- Third-order neurons

**Edinger-Westphal nucleus**

Where in relation to the CN3 nuclear complex is the Edinger-Westphal nucleus located?
It is a part of the complex
**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

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

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

Important intracranial space
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

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 topographic 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)

Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

With respect to the topographic 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 a really important factoid a few slides from now)
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)

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 2,000 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)

---

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

As *oculomotor 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)

This factoid is going to prove important as well!
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?
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]
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)

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

Post-ganglionic neurons
- It divides into two divisions: The Superior, and the Inferior
  --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)

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?
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

Parasympathetic pathway:

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

- **Post-ganglionic 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
  -- 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

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
  -- 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

**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)
  - Exit CS with inferior division of CN3

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**
  --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*
**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 \[\text{ciliary ganglion}\]

**Post-ganglionic neurons**

- **Third order neurons**

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

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

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*Where is the ciliary ganglion located?*
**Parasympathetic pathway:**
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- Second order neurons
  -- Originate in the Edinger-Westphal nucleus
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  -- Exit CS with inferior division of CN3
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**Post-ganglionic neurons**
- Third order neurons

Where is the ciliary ganglion located?
At the orbital apex
**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

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

Nontraumatic, Isolated, Unilateral CN3 Palsy
Parasympathetic pathway:

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

Pre-ganglionic neurons
Second-order neurons
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Post-ganglionic neurons
Third-order neurons
--Originate in ciliary ganglion
--Travel with nerve to the inferior oblique muscle
**Parasympathetic pathway:**

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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

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

First order neurons
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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
- At eye, jumps to nerve to reach the sphincter muscle
Parasympathetic pathway:
- First-order neurons -- ‘Top’ inputs
  -- Originate mainly in the pretectal nuclei

Pre-ganglionic neurons
- Second-order neurons
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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
Parasympathetic pathway:
- First-order neurons—‘Top’ inputs
  --Originated 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-ganglionic to reach their targets.

Post-ganglionic neurons
- Third-order neurons
  --Originated in the ciliary ganglion
  --Travelled with the nerve to the inferior oblique muscle
  --At the eye, jumps to posterior ciliary nerves to reach the sphincter muscle
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving \textit{versus} Pupil-sparing

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?
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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

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 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 parasympathetics run in the superficial, outermost portion of the nerve.
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

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  [arrow]  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.
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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What are the two exceptions?

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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)

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

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What does appropriate mean in this context?

Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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--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 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

Pupil-involving

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

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What are the two exceptions?
--If there is an appropriate trauma hx
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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!
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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

**Pupil-involving**

**Pupil-sparing**

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**What are the three likely causes of an isolated dilated pupil?**

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Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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**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

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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**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-surgery)
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?*

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

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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
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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

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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

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

Pupil-involving

Pupil-sparing

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

Pupil-involving

Pupil-sparing

What does it mean to say a CN3 palsy is pupil-sparing?
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.

It was noted at the outset of the slide-set that most CN3 palsies are ischemic. What is the pathophysiology of this?

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)
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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It was noted at the outset of the slide-set that most CN3 palsies are ischemic. What is the pathophysiology of this?
As with compressive lesions, it’s all about CN3 anatomy. Recall that CN3 is a large-diameter nerve. Because of its size, its inner fibers are too far from its surface to receive oxygen via passive diffusion. Thus, its inner fibers are nourished via vessels that perforate the nerve’s sheath and dive into its substance.

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

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What is the name for blood vessels that service the inner aspect of a nerve?

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Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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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).

What is the name for blood vessels that service the inner aspect of a nerve?
Vasa nervora
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving

Pupil-sparing

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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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As with compressive lesions, it’s all about CN3 anatomy. Recall that CN3 is a large-diameter nerve. Because of its size, its inner fibers are too far from its surface to receive oxygen via passive diffusion. Thus, its inner fibers are nourished via vessels that perforate the nerve’s sheath and dive into its substance. If one of these vasa nervora vessels becomes occluded, the portion of CN3 supplied by it will suffer an ischemic injury, resulting in a 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)
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

What does it mean to say a CN3 palsy is pupil-sparing?
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.

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 nourished not by perforating vasa nervora vessels, but rather via the innumerable 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 affect 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.’

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)
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving

Pupil-sparing

What does it mean to say a CN3 palsy is pupil-sparing?

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.

It was noted at the outset of the slide-set that most CN3 palsies are ischemic. What is the pathophysiology of this?

As with compressive lesions, it's all about CN3 anatomy. Recall that CN3 is a large-diameter nerve. Because of its size, it is richly supplied with vessels that nourish it. 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.

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 are nourished via vessels that perforate the nerve’s sheath and dive into its substance. If one of these vasa nervora vessels becomes occluded, the portion of CN3 supplied by it will suffer an ischemic injury, resulting in a palsy.

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)
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving

What does it mean to say a CN3 palsy is pupil-sparing?

Pupil-sparing means that 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.

It was noted at the outset of the slide-set that most CN3 palsies are ischemic. What is the pathophysiology of this?

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 is nourished via vessels that perforate the nerve's sheath and dive into its substance. If one of these vasa nervora vessels becomes occluded, the portion of CN3 supplied by it will suffer an ischemic injury, resulting in a palsy.

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. 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 intact the parasympathetic input to the pupil. Thus, the pupil will be of normal size and reactivity--no anisocoria, no ‘motor pupil.’

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

**Does this mean a vascular CN3 palsy can't involve the pupil?**

What does it mean to say a CN3 palsy is pupil-sparing?

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It was noted at the outset of the slide-set that most CN3 palsies are ischemic. What is the pathophysiology of this?

As with compressive lesions, it’s all about CN3 anatomy. Recall that CN3 is a large-diameter nerve. Because of its size, CN3 is well-nourished via vessels that perforate the nerve’s sheath and dive into its substance. If one of these vasa nervora vessels becomes occluded, the portion of CN3 supplied by it will suffer an ischemic injury, resulting in a palsy.

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

**Does this mean a vascular CN3 palsy can’t involve the pupil?**
No. Per the BCSC Neuro book, % of vascular thirds are pupil-involving.

**What does it mean to say a CN3 palsy is pupil-sparing?**
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.

**What does it mean to say a CN3 palsy is pupil-involving?**
Involvement of the pupil with a CN3 palsy occurs when the preganglionic 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 intact the parasympathetic input to the pupil. Thus, the pupil will be of normal size and reactivity—no anisocoria, no ‘motor pupil.’
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

**Does this mean a vascular CN3 palsy can’t involve the pupil?**
No. Per the BCSC Neuro book, 20% of vascular thirds are pupil-involving.

What does it mean to say a CN3 palsy is pupil-sparing?
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.

What does it mean to say a CN3 palsy is pupil-involving?
Avascular 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).

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. 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 intact the parasympathetic input to the pupil. Thus, the pupil will be of normal size and reactivity—no anisocoria, no ‘motor pupil.’

Relevant Anatomy: Isolated Ischemia

Readily accessible are nourished via vessels that perforate the nerve’s sheath and dive into its substance. If one of these vasa nervora vessels becomes occluded, the portion of CN3 supplied by it will suffer an ischemic injury, resulting in a 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?

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

What does it mean to say a CN3 palsy is pupil-sparing?

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Does this mean a vascular CN3 palsy can’t involve the pupil?

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

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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Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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

- Pupil-involving
- Pupil-sparing
  - Complete
  - Partial

*With regard to management, pupil-sparing nontraumatic isolated CN3 palsies are divided into two categories. What are they?*
What is meant by referring to a pupil-sparing CN3 palsy as ‘complete’ vs ‘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.
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?
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:
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Motility Disorders: *Nontraumatic, Isolated, Unilateral CN3 Palsy*

What is meant by referring to a pupil-sparing CN3 palsy as ‘complete’ vs ‘partial’?
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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 ;
--the pt is over ; and
--the pt has no hx of
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
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- The pt is a vasculopath;
- the pt is over 50; and
- the pt has no hx of cancer

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

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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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

Pupil-involving

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

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

emergent imaging to rule out an aneurysm.
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.

What should this ‘general medical eval’ consist of?
- Consider checking inflammatory markers (e.g., ESR)

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

### Pupil-involving

### Pupil-sparing

**Complete**

**Partial**

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

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

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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)

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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.

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Emergent imaging to r/o an aneurysm?
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving

Pupil-sparing

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**
- **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?
No! **such pts must be followed**

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

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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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;
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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 3 months
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

- Pupil-involving
- Pupil-sparing

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

- **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

Pupil-involving

Pupil-sparing

Complete

Partial

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

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.

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
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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While following the pt, what are you on the lookout for?
--The onset of pupil involvement; or
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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...
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Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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-- The onset of pupil involvement;
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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
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'?

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

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.

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

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What are you looking for on imaging if...

...anisocoria develops? Dat Pcomm aneurysm
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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'?
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--the pt has no hx of cancer.

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?
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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 malignancy

--Other S/S develop?
A malignancy

--The palsy fails to resolve by month 3?
A malignancy
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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A malignancy should be considered if the palsy fails to resolve by month 3.

While following the pt, what are you on the lookout for?
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What should be done if any of these things come to pass?
Imaging should be pursued.

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.

At what location might one expect a malignancy to be found?
-- The skull base
-- The cavernous sinus
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

Pupil-involving

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

Pupil-involving

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

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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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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?
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
**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

*What are common causes on CN3 palsy in kids?*
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**

*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
Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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*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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- Attempted globe adduction, elevation or depression $\rightarrow$ miosis of the pupil
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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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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?
Both **traumatic** and **compressive** can; on the other hand, **ischemic** **never** does.
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.

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Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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*In this context, to what does the term primary aberrant regeneration refer?*

**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?

**Primary Aberrant regeneration.**

Etiology 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.

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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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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What etiology is suggested by this presentation?
A slowly-expanding compressive lesion in the parasellar region.

Primary

Topic 3: Aberrant regeneration. What the heck is it?
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Motility Disorders: Nontraumatic, Isolated, Unilateral CN3 Palsy

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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).

Primary

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