Vertical Deviations

With regard to strabismus: What does the word comitant mean?
With regard to strabismus: What does the word comitant mean? It means an ocular misalignment is the same in all fields of gaze.
With regard to strabismus: What does the word comitant mean?
It means an ocular misalignment is the same in all fields of gaze

Do vertical deviations tend to be comitant, or incomitant?
With regard to strabismus: What does the word *comitant* mean?
It means an ocular misalignment is the same in all fields of gaze.

*Do vertical deviations tend to be comitant, or incomitant?*
Incomitant (although spread of comitance can occur)
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Incomitant (although spread of comitance can occur)

What is spread of comitance?
With regard to strabismus: What does the word *comitant* mean? It means an ocular misalignment is the same in all fields of gaze.

Do vertical deviations tend to be comitant, or incomitant? Incomitant (although spread of comitance can occur)

What is spread of comitance? The neuroadaptive process in which an initially incomitant deviation gradually becomes comitant.
Vertical Deviations

The Peds book divvies the vertical deviations into two broad categories—what are they?
Vertical Deviations

The Peds book divvies the vertical deviations into two broad categories—what are they?

- Vertical Deviations
  - 2° to oblique dysfunction
  - Uncertain mechanism
Vertical Deviations

2° to oblique dysfunction?  Uncertain mechanism?

Which is the more common cause of vertical deviations?
Vertical Deviations

2º to oblique dysfunction

Which is the more common cause of vertical deviations?
Oblique dysfunction
What are the two oblique muscles?
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)  Inferior Oblique (IO)

Uncertain mechanism

What are the two oblique muscles?
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)  Inferior Oblique (IO)

Uncertain mechanism

Per the Peds book, what are the three basic forms of SO dysfunction leading to a vertical deviation?
Vertical Deviations

2° to oblique dysfunction

- Superior Oblique (SO)
  - Overaction
  - Palsy
  - Brown syndrome

- Inferior Oblique (IO)

Uncertain mechanism

*Per the Peds book, what are the three basic forms of SO dysfunction leading to a vertical deviation?*
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

Overaction
- Palsy
- Brown syndrome

What is the classic exam finding in SO overaction?

Uncertain mechanism

Overaction vs Silicone expander

Why are surgeons reluctant to operate on a patient with bifixation?

Surgery could result in torsional diplopia
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

- Overaction
  - Palsy
  - Brown syndrome

What is the classic exam finding in SO overaction?

- Overelevation vs overdepression
- Abduction vs adduction of the eye
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

Overaction

What is the classic exam finding in SO overaction?
Overdepression of the eye in adduction

Brown syndrome

Palsy

Uncertain mechanism
Vertical Deviations

Bilateral superior oblique overaction
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

Overaction

What is the classic exam finding in SO overaction?
Overdepression of the eye in adduction

Will vertical misalignment be present in primary gaze?

Overaction

Palsy

Brown syndrome

Uncertain mechanism
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

Overaction

What is the classic exam finding in SO overaction?
Overdepression of the eye in adduction

Will vertical misalignment be present in primary gaze?
It will if the overaction is bilateral or asymmetric

Brown syndrome

Palsy

Uncertain mechanism
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

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- Palsy
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Uncertain mechanism
Vertical Deviations

2° to oblique dysfunction

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  - Palsy
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What is the surgical treatment for SO overaction?
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

Overaction

Palsy

Brown syndrome

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Vertical Deviations

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2° to oblique dysfunction

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    - Why are surgeons reluctant to operate on a patient with bifixation? Surgery could result in torsional diplopia

Uncertain mechanism
Vertical Deviations

2° to oblique dysfunction

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2° to oblique dysfunction

Superior Oblique (SO)

Inferior Oblique (IO)

Uncertain mechanism

What is the classic exam finding in SO palsy?

Overaction

Palsy

Brown syndrome
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

Inferior Oblique (IO)

What is the classic exam finding in SO palsy?
-overelevation vs overdepression
-of the eye in
-ABduction vs ADduction

Uncertain mechanism

Overaction

Palsy

Brown syndrome
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

Inferior Oblique (IO)

What is the classic exam finding in SO palsy?
Overelevation of the eye in adduction

Uncertain mechanism

Overaction

Palsy

Brown syndrome
Vertical Deviations

Superior oblique palsy, right
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

Inferior Oblique (IO)

Uncertain mechanism

What is the classic exam finding in SO palsy?
Overelevation of the eye in adduction

Is SO palsy a commonly-encountered entity?

Brown syndrome

Overaction

Palsy
What is the classic exam finding in SO palsy?
Overelevation of the eye in adduction

Is SO palsy a commonly-encountered entity?
Yes—it is the most common paralysis of a single cyclovertical muscle
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

- Overaction
- Palsy

Inferior Oblique (IO)

What is the classic exam finding in SO palsy?
Overelevation of the eye in adduction

Is SO palsy a commonly-encountered entity?
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Upon encountering a SO palsy, what question must you consider early on?
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)
- Overaction
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- Brown syndrome

Inferior Oblique (IO)

Uncertain mechanism

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Overerelevation of the eye in adduction

Is SO palsy a commonly-encountered entity?
Yes—it is the most common paralysis of a single cyclovertical muscle

Upon encountering a SO palsy, what question must you consider early on?
Whether the palsy is congenital, or acquired
Vertical Deviations

Regarding SO palsy: As a general rule:
- congenital SO palsy is much more likely to be unilateral
- acquired SO palsy is much more likely to be bilateral

What is the most common cause of acquired SO palsy?
Closed head trauma

How can you confirm that a SO palsy is congenital?
1) Family-album biopsy (i.e., check old photos for a longstanding head tilt)
2) Assess for increased vertical fusional amplitudes

When diagnosing a unilateral SO palsy, what must you be sure to rule out?
That it’s not in fact an asymmetric bilateral SO palsy

uni- vs bilateral

Overaction
Brown syndrome
Vertical Deviations

Regarding SO palsy: As a general rule:
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2° to oblique dysfunction

Superior Oblique (SO)

Inferior Oblique

--- Overaction

**Palsy**

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Vertical Deviations

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Vertical Deviations

Figure 8-11 Congenital left fourth nerve palsy. A, Note the left hypertropia and right head tilt as a child. B, Forty years later, the right head tilt is still present, but the patient describes more difficulty maintaining single, binocular vision. C, After eye muscle surgery, the diplopia and head tilt have resolved. (Courtesy of Lanning B. Kline, MD.)
**Vertical Deviations**

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Closed head trauma

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[three words exactly]

---

2° to oblique dysfunction

--- Superior Oblique (SO)
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Briefly, to what does the term vertical fusional amplitudes refer?

For pts without a history of congenital SO palsy, how much vertical prism can they accept without losing fusion?
Not much—2-3 prism diopters or so

How much vertical prism can pts with a congenital SO palsy take without losing fusion?
A lot more—in the 12-15 prism diopter range
Vertical Deviations

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2° to oblique dysfunction

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Inferior Oblique (IO)

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In contrast, how large are normal **horizontal fusional amplitudes**?
**Vertical Deviations**

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Not much; 2-3 prism diopters or so

**In contrast, how large are normal horizontal fusional amplitudes?**
Much larger—in the 10-15 prism diopter range
Vertical Deviations

Regarding SO palsy: As a general rule:
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What is the most common cause of acquired SO palsy?
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How much vertical prism can pts with a congenital SO palsy take without losing fusion?
Vertical Deviations

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A lot more—in the # to # prism diopter range
Vertical Deviations

2° to oblique dysfunction

Superior
Oblique (SO)

Inferior
Oblique (IO)

Uncertain mechanism

Brown syndrome

Regarding SO palsy: As a general rule:
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What is the most common cause of acquired SO palsy?
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When diagnosing a unilateral SO palsy, what must you be sure to rule out?

---

2° to oblique dysfunction

Superior Oblique (SO) → Inferior Oblique

→ Overaction

Palsy

→ Brown syndrome
Vertical Deviations

Regarding SO palsy: As a general rule:
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How can you confirm that a SO palsy is congenital?
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When diagnosing a unilateral SO palsy, what must you be sure to rule out?
**That it’s not in fact an asymmetric bilateral SO palsy**

Why should you care whether a palsy is unilateral vs bilateral?
Vertical Deviations

Regarding SO palsy: As a general rule:
--congenital SO palsy is much more likely to be **unilateral**
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What is the most common cause of acquired SO palsy?
Closed head trauma

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When diagnosing a unilateral SO palsy, what must you be sure to rule out?
**That it’s not in fact an asymmetric bilateral SO palsy**

Why should you care whether a palsy is unilateral vs bilateral?
All bilateral SO palsies should be assumed to be acquired. Thus, absent an appropriate head-trauma hx, a bilateral SO palsy represents an ongoing intracranial dz process until proven otherwise. For this reason, it is absolutely vital that one establish with certainty the uni- vs bilaterality of SO palsy!
Vertical Deviations

Regarding SO palsy: As a general rule:

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**Why should you care whether a palsy is unilateral vs bilateral?**

All bilateral SO palsies should be assumed to be acquired. Thus, absent an appropriate head-trauma hx, a bilateral SO palsy represents an ongoing intracranial dz process until proven otherwise. For this reason, it is absolutely vital that one establish with certainty the uni- vs bilaterality of SO palsy!

**What is the most common cause of acquired SO palsy?**

Closed head trauma

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**When diagnosing a unilateral SO palsy, what must you be sure to rule out?**

**That it’s not in fact an asymmetric bilateral SO palsy**

**If a bilateral SO play pt lacks an appropriate trauma hx, what should you do?**

Image them.
Vertical Deviations

Regarding SO palsy: As a general rule:
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**Vertical Deviations**

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That it’s not in fact an asymmetric bilateral SO palsy

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Image them

**What findings differentiate a uni- from a bilateral SO palsy?**

---

**Superior Oblique (SO)**
- Overaction
- Brown syndrome

**Inferior Oblique**

---

**2° to oblique dysfunction**
## Vertical Deviations

Regarding SO palsy: As a general rule:
- congenital SO palsy is much more likely to be unilateral
- acquired SO palsy is much more likely to be bilateral

### When diagnosing a unilateral SO palsy, what must you rule out?
- That it's not in fact an asymmetric bilateral SO palsy

### Key Findings in Uni- vs Bilateral SO Palsy

<table>
<thead>
<tr>
<th></th>
<th>V-pattern ET present?</th>
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</thead>
<tbody>
<tr>
<td><strong>Unilateral SO</strong></td>
<td></td>
</tr>
<tr>
<td>palsy</td>
<td>yes/no</td>
</tr>
<tr>
<td><strong>Bilateral SO</strong></td>
<td></td>
</tr>
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</tr>
</tbody>
</table>

---

Regarding SO palsy:
- Superior Oblique (SO)
- Inferior Oblique
- Overaction
- Palsy
- Brown syndrome

---

### What is the most common cause of acquired SO palsy?
Closed head trauma

### How can you confirm that a SO palsy is congenital?
1. Family-album biopsy (i.e., check old photos for a longstanding head tilt)
2. Check vertical fusional amplitudes (normal ~ 2°; can be as much as 10°)

---

### How much excyclotorsion on Maddox-rod testing?
- Head-tilt test?

<table>
<thead>
<tr>
<th></th>
<th>Head-tilt test?</th>
</tr>
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<tbody>
<tr>
<td><strong>Unilateral</strong></td>
<td></td>
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<tr>
<td>SO palsy</td>
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62 Brown syndrome
Vertical Deviations

Regarding SO palsy: As a general rule:
-- congenital SO palsy is much more likely to be unilateral
-- acquired SO palsy is much more likely to be bilateral

What is the most common cause of acquired SO palsy?
Closed head trauma

How can you confirm that a SO palsy is congenital?
1) Family-album biopsy (i.e., check old photos for a longstanding head tilt)
2) Check vertical fusional amplitudes (normal ~ 2 \( \Delta \); can be as high as 12-15 \( \Delta \) in congenital SO palsy)

When diagnosing a unilateral SO palsy, what must you be sure to rule out?
V-pattern ET present?

How much excyclotorsion on Maddox-rod testing?

Head-tilt test?


<table>
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When diagnosing a unilateral SO palsy, what V-pattern ET pattern present?

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<td>Positive to one side only</td>
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| **Bilateral**  |
| **SO palsy**    |
| Yes             |
| May be more than | # of degrees |
| # of degrees    |
**Vertical Deviations**

Regarding SO palsy: As a general rule:
-- congenital SO palsy is much more likely to be unilateral
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What is the most common cause of acquired SO palsy? Closed head trauma

**Key Findings in Uni-vs Bilateral SO Palsy**

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2° to oblique dysfunction

Superior Oblique (SO)  Inferior Oblique

---

Overaction

Palsy

Brown syndrome
## Vertical Deviations

- **2° to oblique dysfunction**
- Superior Oblique (SO)
- Inferior Oblique
- Overaction
- Palsy
- Brown syndrome

### Regarding SO palsy:
- As a general rule:
  - Acquired SO palsy is much more likely to be **unilateral**
  - Acquired SO palsy is much more likely to be **bilateral**

### What is the most common cause of acquired SO palsy?
- Closed head trauma

### Key Findings in Uni- vs Bilateral SO Palsy

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What is *double Maddox rod testing*? I’m glad you asked…
What is a Maddox rod?

A translucent disc of red plastic constructed of a set of very small cylinders aligned parallel to one another.

What does a pt see when shown a point-source of light through a Maddox rod?

The point of light is seen as a line oriented 90° from the orientation of the cylinders.

What is double Maddox-rod testing, and how is it used to identify and quantify excyclotorsion?

In the double Maddox rod test, a separate Maddox rod is placed before each eye, and a point-source of light is presented to both eyes simultaneously. Thus, each eye sees its own line, courtesy of its Maddox rod. In individuals for whom their eyes have identical rotational orientation, the line seen by each eye will be perceived as parallel to the other. However, because an eye with a SO palsy is excyclotorted, the line produced by its Maddox rod will be in a different orientation than that experienced by its non-torted fellow eye. (Bear in mind that it's not the orientation of the line itself that's off; rather, it's the orientation of the retina perceiving the line that's off.)

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The Maddox-rod lenses can be mounted in trial frames that allow the orientation of the cylinders to be changed, and the pt is instructed to do so until s/he perceives the lines to be parallel. The difference in degrees between the orientation of the two sets of cylinders is the size of the excyclotorsion.
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Vertical Deviations

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Sometimes a clear Maddox rod is used for one eye

Double Maddox rod setup
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Double Maddox rod test in individual with a right SO palsy
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The maximum amount of excyclotorsion that can result from unilateral SO palsy is 10 deg. Thus, if more than this amount is present, bilateral palsies must be present.
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The maximum amount of excyclotorsion that can result from unilateral SO palsy is 10 deg. Thus, any excyclotorsion of greater than 10 deg must be bilateral.

This means that if less than 10 deg is present, the palsy must be unilateral, right?
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All that said, it is very unusual for a bilateral SO palsy to present with less than 10 deg of torsion.
**Vertical Deviations**

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The maximum amount of excyclotorsion that can result from unilateral SO palsy is 10°. Thus, if excyclotorsion is measured at anything over 10°, the palsy must be bilateral. This means that if less than 10 deg is present, the palsy must be unilateral, right? Slow ya roll, bruh. It’s true that if only one eye is excyclotorted, the total measured excyclotorsion is always 10 deg or less. However, if both eyes are only mildly palsied—say, 4 degree’s worth each—the total excyclotorsion (in this case 8 deg) could be less than 10. Thus, whereas >10 deg rules out unilateral SO palsy, <10 does not rule it in.

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How can the size of the excyclotorsion be used to differentiate between unilateral and bilateral SO palsies?
The maximum amount of excyclotorsion that can result from unilateral SO palsy is 10 deg. This means that if less than 10 deg is present, the palsy must be unilateral, right? Slow ya roll, bruh. It’s true that if only one eye is excyclotorted, the total measured excyclotorsion is always 10 deg or less. However, if both eyes are only mildly palsied—say, 4 degree’s worth each—the total excyclotorsion (in this case 8 deg) could be less than the maximum allowed by a unilateral palsy, <10 does not rule it in. All that said, it is very unusual for a bilateral SO palsy to present with less than 5 deg of torsion.

TLDR
>10 excyclotorsion is always bilateral
<5 (but greater than 0, duh) is almost always unilateral
5-10 is indeterminate
Vertical Deviations

Regarding SO palsy: As a general rule:
--congenital SO palsy is much more likely to be unilateral
--acquired SO palsy is much more likely to be bilateral

What is the most common cause of acquired SO palsy?

---

Key Findings in Uni- vs Bilateral SO Palsy

<table>
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Superior Oblique (SO)

 Inferior Oblique (IO)

---

2° to oblique dysfunction

---

Overaction

Brown syndrome

---

Brown syndrome

---

Next question!
Vertical Deviations

Regarding SO palsy: As a general rule:
-- congenital SO palsy is much more likely to be unilateral
-- acquired SO palsy is much more likely to be bilateral

What is the most common cause of acquired SO palsy?
Closed head trauma

How can you confirm that a SO palsy is congenital?
1) Family-album biopsy (i.e., check old photos for a longstanding head tilt)
2) Check vertical fusional amplitudes (normal ~ 2°; can be as high as 12-15° in congenital SO palsy)

When diagnosing a unilateral SO palsy, what V-pattern ET present?

How much excyclotorsion on double Maddox rod testing?

Head-tilt test?

Unilateral SO palsy
V-pattern ET present? No
How much excyclotorsion on double Maddox rod testing? Always less than 10°
Head-tilt test? Positive to one side only

Bilateral SO palsy
V-pattern ET present? Yes
How much excyclotorsion on double Maddox rod testing? May be more than 10°
Head-tilt test? Positive to both sides

Key Findings in Uni- vs Bilateral SO Palsy

Next question!
### Vertical Deviations

**Regarding SO palsy: As a general rule:**
- Congenital SO palsy is much more likely to be **unilateral**
- Acquired SO palsy is much more likely to be **bilateral**

**What is the most common cause of acquired SO palsy?**

How can you confirm that a SO palsy is congenital?
1. **Family-album biopsy** (i.e., check old photos for a longstanding head tilt)
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When diagnosing a unilateral SO palsy, what V-pattern ET present?
- **Unilateral SO palsy**
  - No
  - Always less than 10°
  - Positive to one side only

- **Bilateral SO palsy**
  - Yes
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**Key Findings in Uni- vs Bilateral SO Palsy**

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What is the *head-tilt test*? I’m glad you asked…
The head-tilt test is also known by what eponymous name?

- The Beilschowsky head-tilt test

The head-tilt test is actually a single component of what double-eponymous 3-step test?

- The Parks-Bielschowsky 3-step test

Generally speaking, what is the purpose/goal of the Parks-Bielschowsky 3-step test?

To identify the cyclovertical muscle responsible for a vertical deviation.

How is the head-tilt test performed?

The pt is told to tilt their head first to one side, then to the other, while you observe their eyes. A SO palsy is present if the eye on the side toward which the head is tilted responds to the tilt by drifting up (ie, by becoming hypertropic).
Vertical Deviations

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*Note: The Parks-Bielschowsky test works if and only if weakness of a single muscle is responsible for the vertical deviation in question!
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The pt is told to tilt their head first to one side, then to the other, while you observe their eyes. A SO palsy is present if the eye on the side toward which the head is tilted responds to the tilt by drifting up (ie, by becoming hyper-tropia).
Vertical Deviations

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Vertical Deviations

Left SO palsy: Positive head tilt test
Vertical Deviations

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Why does a head-tilt cause an SO palsy eye to become hyperopic?

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**Why does a head-tilt cause an SO palsy eye to become hyperopic?**
It has to do with a ‘righting reflex’ in the ocular control system. When the head is tilted to one side, the eyes attempt to remain level (= superior poles pointing toward the ceiling) by counter-torting in the other direction.

Eyes. A SO palsy is present if the eye on the side toward which the head is tilted responds to the tilt by drifting up (ie, by becoming hypertropic).
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When a SO palsy is present on the side to which the head is tilted, the eye will attempt to intort *becoming hypertropic*.

Recall that the intorters of the eye are the **superior rectus** and the **superior oblique** (you can remember this with the mnemonic **SIN**, which stands for **Superiors Intort**). Thus, when an eye attempts to intort, both the SR and the SO fire. Note that the SR and the SO also have equal—but-opposite vertical components to their actions—the SR elevates the eye, while the SO depresses it. So when both muscles fire simultaneously, their vertical components cancel each other out, and the eye simply intorts.

Now consider what happens upon head tilt if the eye on that side has a SO palsy. Attempted intorsion results in contraction of the SR only (because the palsied SO cannot contract). Thus, the vertical component of the SR contraction is unopposed, and because it is unopposed, the eye elevates. This is why an eye with a SO palsy demonstrates a hypertropia upon head tilt to that side!
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Vertical Deviations

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Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

Inferior Oblique (IO)

Uncertain mechanism

Management of **unilateral** SO palsy:
-- If no IO overaction is present: [surgery]
Brown syndrome

Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

Inferior Oblique (IO)

Uncertain mechanism

Management of unilateral SO palsy:
--If no IO overaction is present: **Contralateral IR recession**
Vertical Deviations

2° to oblique dysfunction

Uncertain mechanism

Superior Oblique (SO)

Inferior Oblique (IO)

Management of unilateral SO palsy:
--If no IO overaction is present: **Contralateral IR recession**

Management of bilateral SO palsy:
--If main c/o is torsional diplopia: **Harada-Ito procedure**

Wha? Why perform contralateral IR recession for unilateral SO palsy?
Brown syndrome

Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

Inferior Oblique (IO)

Uncertain mechanism

Management of unilateral SO palsy:
--If no IO overaction is present: Contralateral IR recession

Wha? Why perform contralateral IR recession for unilateral SO palsy?
Patients with an SO palsy c/o diplopia in downgaze. This is because the unaffected eye can depress fully, but the eye with the SO palsy cannot. The contralateral IR is the yoke muscle for the palsied SO. By recessing the contralateral IR, you inhibit that eye’s ability to depress, thereby eliminating the source of diplopia (i.e., the asymmetry in depression).
Vertical Deviations

Management of unilateral SO palsy:
--If no IO overaction is present: Contralateral IR recession

Wha? Why perform contralateral IR recession for unilateral SO palsy? Patients with an SO palsy c/o diplopia in downgaze. This is because the unaffected eye can depress fully, but the eye with the SO palsy cannot. The contralateral IR is the yoke muscle for the palsied SO. By recessing the contralateral IR, you inhibit that eye’s ability to depress, thereby eliminating the source of diplopia (i.e., the asymmetry in depression). In essence, you treat a unilateral motility problem by giving the patient a bilateral motility problem.
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

Inferior Oblique (IO)

Uncertain mechanism

Management of unilateral SO palsy:

--If no IO overaction is present: **Contralateral IR recession**

--If IO overaction is present, but deviation is <15°: [surgery]
Vertical Deviations

$\pm 2^\circ$ to oblique dysfunction

2nd to oblique dysfunction

Palsy

Superior Oblique (SO)

-- Overaction

Brown syndrome

Inferior Oblique (IO)

-- Overaction

Uncertain mechanism

Management of unilateral SO palsy:

-- If no IO overaction is present: **Contralateral IR recession**

-- If IO overaction is present, but deviation is $<15\Delta$:

  **IO weakening procedure**
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

Inferior Oblique (IO)

Uncertain mechanism

Overaction

--If no IO overaction is present: **Contralateral IR recession**

--If IO overaction is present, but deviation is <15Δ: **IO weakening procedure**

--If IO overaction is present and the deviation is >15Δ: [surgery]

Management of **unilateral** SO palsy:

Palsy

Brown syndrome
Vertical Deviations

2° to oblique dysfunction

2° to oblique dysfunction

Uncertain mechanism

Superior Oblique (SO)

Inferior Oblique (IO)

Overaction

Palsy

Brown syndrome

Management of unilateral SO palsy:
-- If no IO overaction is present: **Contralateral IR recession**
-- If IO overaction is present, but deviation is <15Δ:
  **IO weakening procedure**
-- If IO overaction is present and the deviation is >15Δ:
  **Perform both**
**Vertical Deviations**

2° to oblique dysfunction

**Superior Oblique (SO)**
- **Palsy**
- **Brown syndrome**
- **Overaction**

**Inferior Oblique (IO)**
- **Palsy**

**Uncertain mechanism**

**Management of unilateral SO palsy:**
- If no IO overaction is present: **Contralateral IR recession**
- If IO overaction is present, but deviation is <15Δ:
  - **IO weakening procedure**
- If IO overaction is present and the deviation is >15Δ:
  - **Perform both**

**Management of bilateral SO palsy:**
- If main c/o is torsional diplopia: [surgery]
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

Inferior Oblique (IO)

Uncertain mechanism

Management of \textit{unilateral} SO palsy:
--If no IO overaction is present: \textbf{Contralateral IR recession}
--If IO overaction is present, but deviation is \(<15\Delta\):
  \begin{itemize}
    \item \textbf{IO weakening procedure}
  \end{itemize}
--If IO overaction is present and the deviation is \(>15\Delta\):
  \textbf{Perform both}

Management of \textit{bilateral} SO palsy:
--If main c/o is torsional diplopia: \textbf{Harada-Ito procedure}
Vertical Deviations

2° to oblique dysfunction

Uncertain mechanism

Superior Oblique (SO)

Inferior Oblique (IO)

Management of unilateral SO palsy:
--If no IO overaction is present: Contralateral IR recession
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--If IO overaction is present and the deviation is >15Δ: Perform both

Management of bilateral SO palsy:
--If main c/o is torsional diplopia: Harada-Ito procedure

Briefly, what is the Harada-Ito procedure?

Both SO tendons are split, and the anterior portion of each is repositioned anteriorly and temporally.
Brown syndrome

Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

Inferior Oblique (IO)

Uncertain mechanism

Management of unilateral SO palsy:
- If no IO overaction is present: Contralateral IR recession
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Management of bilateral SO palsy:
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Vertical Deviations

2° to oblique dysfunction

Uncertain mechanism

Superior Oblique (SO)

Inferior Oblique (IO)

Brown syndrome

Palsy

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- If main c/o is torsional diplopia
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Briefly, what is the Harada-Ito procedure?
Both SO tendons are split, and the anterior portion of each is repositioned anteriorly and temporally.
Vertical Deviations

Harada-Ito procedure
In the present context, what is a skew deviation?

Skew deviation is a vertical deviation secondary to dysfunction of the vestibulo-ocular system (aka the vestibular-ocular reflex, VOR). Why is skew deviation being mentioned here? Because it can easily be mistaken for a SO palsy.

Dysfunction of the VOR occurs in one of two general locations: Superior Oblique (SO) and Inferior Oblique (IO).
Vertical Deviations

In the present context, what is a skew deviation?
A vertical deviation secondary to dysfunction of the vestibular-ocular system.

2º to

Superior Oblique (SO)  Inferior Oblique (IO)

- Overaction
- Palsy
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Dysfunction of the VOR occurs in one of two general locations: Overaction or Palsy.

Brown syndrome
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Superior Oblique (SO)  Inferior Oblique (IO)
- Overaction
- Palsy
- Brown syndrome
In the present context, what is a skew deviation? A vertical deviation secondary to dysfunction of the vestibular-ocular system (aka the vestibular-ocular reflex, VOR).

What is the vestibular-ocular system? It is one of the six ocular motor systems that 1) facilitate bifixation of an object of regard, as well as 2) smoothly and rapidly reorient gaze when a new object of regard is detected in the visual periphery. Because they innervate the nuclei of the peripheral nerves that control eye movements, these systems are referred to as supranuclear pathways.
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Vertical Deviations

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A vertical deviation secondary to dysfunction of the vestibular-ocular system (aka the vestibular-ocular reflex, VOR).

What is the vestibular-ocular system?
It is one of the six ocular motor systems that 1) facilitate bifixation of an object of regard, as well as 2) smoothly and rapidly reorient gaze when a new object of regard is detected in the visual periphery.

What general term is used to refer to these six control systems?
In the present context, what is a skew deviation?
A vertical deviation secondary to dysfunction of the vestibular-ocular system (aka the vestibular-ocular reflex, VOR).

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Because they innervate the nuclei of the peripheral nerves that control eye movements, these systems are referred to as supranuclear pathways.
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Why is skew deviation being mentioned here?

Superior Oblique (SO)  Inferior Oblique (IO)

- Overaction
- Palsy
- Brown syndrome
In the present context, what is a skew deviation?
A vertical deviation secondary to dysfunction of the vestibular-ocular system (aka the vestibular-ocular reflex, VOR)

Why is skew deviation being mentioned here?
Because it can easily be mistaken for a SO palsy

Superior Oblique (SO)  Inferior Oblique (IO)

— Overaction

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Can't they be distinguished via the 3-step test?

Superior Oblique (SO)  Inferior Oblique (IO)

Overaction  Palsy  Brown syndrome
In the present context, what is a skew deviation?
A vertical deviation secondary to dysfunction of the vestibular-ocular system (aka the vestibular-ocular reflex, VOR)

Why is skew deviation being mentioned here?
Because it can easily be mistaken for a SO palsy

Can’t they be distinguished via the 3-step test?
Unfortunately no—skew deviation may ‘pass’ the test as a SO palsy

Brown syndrome
Brown syndrome

Vertical Deviations

In the present context, what is a skew deviation?
A vertical deviation secondary to dysfunction of the vestibular-ocular system
(aka the vestibular-ocular reflex, VOR)

Why is skew deviation being mentioned here?
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Dysfunction of the VOR occurs in one of two general locations—what are they?

Superior Oblique (SO)  Inferior Oblique (IO)

Overaction  Palsy  Brown syndrome

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- Superior Oblique (SO)
- Inferior Oblique (IO)

- Overaction
- Brown syndrome
- Palsy
- Central
- Peripheral
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

Inferior Oblique (IO)

Overaction

Brown syndrome

A ‘central’ VOR lesion—in which portion of the CNS is it located?

Dysfunction of the VOR occurs in one of two general locations—what are they?

Central

Peripheral

Palsy

In the present context, what is a skew deviation?

A vertical deviation secondary to dysfunction of the vestibular-ocular system (aka the vestibular-ocular reflex, VOR)

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Dysfunction of the VOR occurs in one of two general locations—what are they?

Central

Peripheral
In the present context, what is a skew deviation?

A vertical deviation secondary to dysfunction of the vestibular-ocular system (aka the vestibular-ocular reflex, VOR)

Why is skew deviation being mentioned here?

Because it can easily be mistaken for a SO palsy

Dysfunction of the VOR occurs in one of two general locations—what are they?

Central

Peripheral

A ‘central’ VOR lesion—in which portion of the CNS is it located?
The brainstem

Superior Oblique (SO)

Inferior Oblique (IO)

Central

Peripheral

Overaction

Palsy

Brown syndrome
Vertical Deviations

2° to oblique dysfunction

In the present context, what is a skew deviation?
A vertical deviation secondary to dysfunction of the vestibular-ocular system (aka the vestibular-ocular reflex, VOR)

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Dysfunction of the VOR occurs in one of two general locations—what are they?

- A ‘central’ VOR lesion—in which portion of the CNS is it located?
  The brainstem
- Likewise, a ‘peripheral’ VOR lesion—to what structure/area does this locate?
  To the vestibular apparatus of the inner ear

Superior Oblique (SO)
- Overaction
- Palsy

Inferior Oblique (IO)
- Brown syndrome

Central

Peripheral
In the present context, what is a skew deviation?
A vertical deviation secondary to dysfunction of the vestibular-ocular system (aka the vestibular-ocular reflex, VOR).

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Dysfunction of the VOR occurs in one of two general locations—what are they?

- A ‘central’ VOR lesion—in which portion of the CNS is it located?
  The brainstem.

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  To the vestibular apparatus of the inner ear.

Superior Oblique (SO)
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- Brown syndrome

Inferior Oblique (IO)
- Central
- Peripheral
In the present context, what is a skew deviation?

A vertical deviation secondary to dysfunction of the vestibular-ocular system (aka the vestibular-ocular reflex, VOR)

Why is skew deviation being mentioned here?

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Dysfunction of the VOR occurs in one of two general locations—what are they?

A ‘central’ VOR lesion—in which portion of the CNS is it located?
The brainstem

Likewise, a ‘peripheral’ VOR lesion—to what structure/area does this locate?
To the vestibular apparatus of the inner ear

What are the two major components of the vestibular apparatus?
Vertical Deviations

In the present context, what is a skew deviation?
A vertical deviation secondary to dysfunction of the vestibular-ocular system (aka the vestibular-ocular reflex, VOR).

Why is skew deviation being mentioned here?
Because it can easily be mistaken for a SO palsy.

Dysfunction of the VOR occurs in one of two general locations—what are they?
(a) Central
(b) Peripheral

A ‘central’ VOR lesion—in which portion of the CNS is it located?
The brainstem.

Likewise, a ‘peripheral’ VOR lesion—to what structure/area does this locate?
To the vestibular apparatus of the inner ear.

What are the two major components of the vestibular apparatus?
The semicircular canals and the otoliths.

Superior Oblique (SO)  Inferior Oblique (IO)

— Overaction
— Palsy
— Brown syndrome

Central
Peripheral
Semicircular canals
Otoliths
In the present context, what is a skew deviation?
A vertical deviation secondary to dysfunction of the vestibular-ocular system (aka the vestibular-ocular reflex, VOR)

Why is skew deviation being mentioned here?
Because it can easily be mistaken for a SO palsy

Dysfunction of the VOR occurs in one of two general locations—what are they?

Of the three locations, damage to which is most likely to result in a skew deviation?
Vertical Deviations

In the present context, what is a skew deviation?
A vertical deviation secondary to dysfunction of the vestibular-ocular system (aka the vestibular-ocular reflex, VOR).

Why is skew deviation being mentioned here?
Because it can easily be mistaken for a SO palsy.

Dysfunction of the VOR occurs in one of two general locations—what are they?

Superior Oblique (SO)

Inferior Oblique (IO)

Central

Peripheral

Of the three locations, damage to which is most likely to result in a skew deviation? The otoliths.

Of the three locations, damage to which is most likely to result in a skew deviation? The otoliths.
**Vertical Deviations**

A vertical deviation secondary to dysfunction of the vestibular-ocular system (aka the vestibular-ocular reflex, VOR) can be due to a skew deviation.

**Why is skew deviation being mentioned here?**

Because it can easily be mistaken for a SO palsy.

**Dysfunction of the VOR occurs in one of two general locations**

- **Central**
- **Peripheral**

Of the three locations, damage to which is most likely to result in a skew deviation?

- **The otoliths**

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**Overaction**

**Palsy**

**Brown syndrome**

---

**Central**

**Peripheral**

**Otoliths!**

---

**Semicircular canals**

---

**Of the three locations, damage to which is most likely to result in a skew deviation?**

- The otoliths
Brown syndrome

Vertical Deviations

They can’t reliably be differentiated via the 3-step test...But they can be differentiated based on a simple clinical observation, as well as a simple maneuver.

(No question yet—keep going)

A vertical deviation secondary to dysfunction of the vestibular-ocular system (aka the vestibulo-ocular reflex, VOR)

Why is skew deviation being mentioned here?

Because it can easily be mistaken for a SO palsy

Dysfunction of the VOR occurs in one of two general locations

— Central
— Peripheral

Semicircular canals
Otoliths!

Positive 3-step test?

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Of the three locations, damage to which is most likely to result in a skew deviation?
The otoliths

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Of the three locations, damage to which is most likely to result in a skew deviation?

The otoliths

Central

Peripheral

Otoliths!

Semicircular canals

Brown syndrome

Overaction

Palsy
Vertical Deviations

They can't reliably be differentiated via the 3-step test... But they can be differentiated based on a simple clinical observation, as well as a simple maneuver. What is the observation? Is the eye intorted, or extorted?

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If the eye is intorted,
SO palsy

If the eye is extorted,
Skew

Of the three locations, damage to which is most likely to result in a skew deviation? The otoliths
Vertical Deviations

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Central

Peripheral

Overaction

Palsy

Brown syndrome

Semicircular canals

Otoliths!
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Of the three locations, damage to which is most likely to result in a skew deviation? The otololiths

Peripheral

Central

Semicircular canals

Otoliths!

Brown syndrome

Overaction

Palsy
Vertical Deviations

A vertical deviation secondary to dysfunction of the vestibular-ocular system (aka the vestibular-ocular reflex, VOR) can easily be mistaken for a SO palsy. Dysfunction of the VOR occurs in one of two general locations: central or peripheral. Of the three locations, damage to which is most likely to result in a skew deviation? The otoliths.

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Recall that the SO is an intorter of the eye, so it follows that an SO palsy results in extorsion.

They can’t reliably be differentiated via the 3-step test... But they can be differentiated based on a simple clinical observation, as well as a simple maneuver. What is the observation? Is the eye intorted, or extorted?

Of the three locations, damage to which is most likely to result in a skew deviation? The otoliths.
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Recall that the SO is an intorter of the eye, so it follows that an SO palsy results in extorsion. In contrast, the hyper eye in skew deviation is usually intorted.

Of the three locations, damage to which is most likely to result in a skew deviation? The otoliths!

---

Brown syndrome

Overaction

Palsy

Semicircular canals

Otoliths!
Vertical Deviations

They can’t reliably be differentiated via the 3-step test...But they can be differentiated based on a simple clinical observation, as well as a simple maneuver.

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Recall that the SO is an intorter of the eye, so it follows that an SO palsy results in extorsion. In contrast, the hyper eye in skew deviation is usually intorted.

How does one go about determining whether an eye is intorted or extorted?
Vertical Deviations

They can’t reliably be differentiated via the 3-step test...But they can be differentiated based on a simple clinical observation, as well as a simple maneuver. What is the observation? Is the eye intorted, or extorted?

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Recall that the SO is an intorter of the eye, so it follows that an SO palsy results in extorsion. In contrast, the hyper eye in skew deviation is usually intorted.

How does one go about determining whether an eye is intorted or extorted? Probably the best method is via DFE, by taking note of the relative positions of the ONH and macula.
Brown syndrome

Vertical Deviations

They can’t reliably be differentiated via the 3-step test…But they can be differentiated based on a simple clinical observation, as well as a simple maneuver.

What is the observation? Is the eye intorted, or extorted?

What is the maneuver?

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<tr>
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<tr>
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<td>Yes</td>
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Of the three locations, damage to which is most likely to result in a skew deviation?
The otoliths
Vertical Deviations

They can't reliably be differentiated via the 3-step test... But they can be differentiated based on a simple clinical observation, as well as a simple maneuver.

What is the observation? Is the eye intorted, or extorted?
What is the maneuver? Does the hyper resolve if the pt lies supine?

<table>
<thead>
<tr>
<th>N</th>
<th>Central Palsy</th>
<th>Positive 3-step test?</th>
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<tr>
<td>S</td>
<td>Superior Ocular</td>
<td>Yes</td>
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Of the three locations, damage to which is most likely to result in a skew deviation?
The otoliths

Brown syndrome

Overaction

Palsy

Central

Peripheral

Semicircular canals

Otoliths!
Vertical Deviations

In the present context, what is a skew deviation? A vertical deviation secondary to dysfunction of the vestibular-ocular system (aka the vestibular-ocular reflex, VOR).

Why is skew deviation being mentioned here? Because it can easily be mistaken for a SO palsy.

Dysfunction of the VOR occurs in one of two general locations: central or peripheral.

Semicircular canals

Otoliths!

Of the three locations, damage to which is most likely to result in a skew deviation? The otoliths.
Vertical Deviations

They can’t reliably be differentiated via the 3-step test…But they can be differentiated based on a simple clinical observation, as well as a simple maneuver. What is the observation? Is the eye intorted, or extorted? What is the maneuver? Does the hyper resolve if the pt lies supine?

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Of the three locations, damage to which is most likely to result in a skew deviation? The otoliths
Vertical Deviations

In the present context, what is a skew deviation?

A vertical deviation secondary to dysfunction of the vestibular-ocular system (aka the vestibular-ocular reflex, VOR).

Why is skew deviation being mentioned here?

Because it can easily be mistaken for a SO palsy.

Dysfunction of the VOR occurs in one of two general locations—what are they?

Central Peripheral

Semicircular canals

Otoliths!

Of the three locations, damage to which is most likely to result in a skew deviation?

The otoliths

Positive 3-step test?

Eye intorted, or extorted?

Resolves when supine?

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Take note—these are the traits that differentiate skew from SO palsy!
Vertical Deviations

Define Brown syndrome:

- 2° to oblique dysfunction
- Superior Oblique (SO)
- Inferior Oblique
- Overaction
- Palsy
- Brown syndrome
Define Brown syndrome:
Deficient elevation in adduction 2° to restriction of the SO tendon at the trochlea.

Brown syndrome:
Overaction
Palsy
Vertical Deviations

Right Brown syndrome
Define Brown syndrome:
Deficient elevation in adduction 2° to restriction of the SO tendon at the trochlea

Is Brown syndrome more common in…
…males or females?
…OD or OS?

2° to oblique dysfunction

Superior Oblique (SO)

Inferior Oblique (IO)

Overaction

Palsy

Brown syndrome
Define **Brown syndrome**: Deficient elevation in adduction 2° to restriction of the SO tendon at the trochlea.

Is Brown syndrome more common in... males or females? **Males**

...OD or OS? **OD**
**Vertical Deviations**

2° to oblique dysfunction

Superior Oblique (SO)

 Inferior Oblique

Define **Brown syndrome**: Deficient elevation in adduction 2° to restriction of the SO tendon at the trochlea

*Is Brown syndrome more common in…* males or females? **Males**

*…OD or OS?** **OD**

*What common strabismus syndrome has the opposite pattern (i.e., is more common in **females** and **left eyes**)?*

---

- Overaction
- Palsy

**Brown syndrome**
**Define Brown syndrome:** Deficient elevation in adduction 2° to restriction of the SO tendon at the trochlea

*Is Brown syndrome more common in...* 
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...OD or OS? **OD**

*What common strabismus syndrome has the opposite pattern (i.e., is more common in females and left eyes)?* 
**Duane syndrome**
Define **Brown syndrome**: Deficient elevation in adduction 2° to restriction of the SO tendon at the trochlea.

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*Name three causes of SO restriction at the trochlea:*
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Define **Brown syndrome**: Deficient elevation in adduction 2° to restriction of the SO tendon at the trochlea.

Is Brown syndrome more common in…
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...OD or OS? **OD**

What common strabismus syndrome has the opposite pattern (i.e., is more common in **females** and **left** eyes)? **Duane syndrome**

Name three causes of SO restriction at the trochlea:
--**Idiopathic/congenital** (i.e., born with a short tendon)
--**Traumatic**
--**Inflammatory**
Define Brown syndrome: Deficient elevation in adduction 2° to restriction of the SO tendon at the trochlea.

Is Brown syndrome more common in... males or females? Males
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Name three causes of SO restriction at the trochlea:
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In addition to restricted elevation, what else occurs during adduction in Brown syndrome?
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Vertical Deviations

**Define Brown syndrome:** Deficient elevation in adduction 2° to restriction of the SO tendon at the trochlea

**Is Brown syndrome more common in...**

...males or females? **Males**

...OD or OS? **OD**

**What common strabismus syndrome has the opposite pattern (i.e., is more common in females and left eyes)?**

**Duane syndrome**

**Name three causes of SO restriction at the trochlea:**

--**Idiopathic/congenital** (ie, born with a short tendon)

--**Traumatic**

--**Inflammatory**

**In addition to restricted elevation, what else occurs during adduction in Brown syndrome?**

--The palpebral fissure widens

--The eye may involuntarily depress (called downshoot)
Vertical Deviations

Define Brown syndrome: Deficient elevation in adduction 2° to restriction of the SO tendon at the trochlea.

Is Brown syndrome more common in... males or females? Males. OD or OS? OD.

What common strabismus syndrome has the opposite pattern (i.e., is more common in females and left eyes)? Duane syndrome.

Name three causes of SO restriction at the trochlea: idiopathic/congenital (i.e., born with a short tendon), traumatic, inflammatory.

In addition to restricted elevation, what else occurs during adduction in Brown syndrome? The palpebral fissure widens. The eye may involuntarily depress (called downshoot).

Briefly, what is Duane syndrome? A motility disorder with the following key findings: at least some limitation of horizontal movement, attempted adduction causes the globe to retract, and may cause it to up- or downshoot. What is the cause? The nucleus for cranial nerve VI is missing, and the lateral rectus is innervated by cranial nerve III.
Vertical Deviations

**Define Brown syndrome:**
Deficient elevation in adduction 2° to restriction of the SO tendon at the trochlea

*Is Brown syndrome more common in...*  
...males or females? **Males**  
...OD or OS? **OD**

*What common strabismus syndrome has the opposite pattern (i.e., is more common in females and left eyes)?*  
**Duane syndrome**

**Briefly, what is Duane syndrome?**
A motility disorder with the following key findings:  
--At least some limitation of horizontal movement  
--At least some limitation of vertical movement

**Description of Duane syndrome:**
- At least some limitation of horizontal movement
- Attempted adduction causes the globe to retract, and may cause it to up- or downshoot

**Cause:**
The nucleus for cranial nerve VI is missing, and the lateral rectus is innervated by cranial nerve III.
**Vertical Deviations**

Define Brown syndrome:
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In addition to restricted elevation, what else occurs during adduction in Brown syndrome?
--The palpebral fissure widens
--The eye may involuntarily depress (called downshoot)

The nucleus for cranial nerve VI is missing, and the lateral rectus is innervated by cranial nerve III

The eye may involuntarily depress (called downshoot)
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What is the cause?

The eye may involuntarily express (called downshoot)
Vertical Deviations

Define Brown syndrome:
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A motility disorder with the following key findings:
--At least some limitation of horizontal movement
--Attempted adduction causes the globe to retract, and may cause it to up- or downshoot

What is the cause?
The nucleus for cranial nerve # is missing, and the rectus is innervated by cranial nerve #.

The eye may involuntarily express (called downshoot).
Vertical Deviations

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How does this...
Vertical Deviations

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What is the cause?
The nucleus for cranial nerve VI is missing, and the lateral rectus is innervated by cranial nerve III

No question yet, keep going (this one is rhetorical)

How does this…
The eye may involuntarily depress (called downshoot)
Vertical Deviations

When someone with an intact oculomotor system adducts their eye, innervation is increased to the medial rectus (as it should be) and decreased to the lateral rectus (also as it should be).

*(No question—continue when ready)*

**Briefly, what is Duane syndrome?**
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**Brown syndrome**
Deficient elevation in adduction 2° to restriction of the SO tendon at the trochlea

Is Brown syndrome more common in males or females?
Males OD or OS?

What common strabismus syndrome has the opposite pattern (i.e., is more common in females and left eyes)?

**Duane syndrome**

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**Duane syndrome**

How does this...
Vertical Deviations

When someone with an intact oculomotor system adducts their eye, innervation is increased to the medial rectus (as it should be) and decreased to the lateral rectus (also as it should be). However, in a Duane’s pt CN3 innervates the LR, so when she attempts to adduct her eye, innervation is increased to both the medial rectus and the aberrantly-innervated lateral rectus, so the eye doesn’t adduct.

(No question—continue when ready)

Briefly, what is Duane syndrome?
A motility disorder with the following key findings:
-- At least some limitation of horizontal movement
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What is the cause?
The nucleus for cranial nerve VI is missing, and the lateral rectus is innervated by cranial nerve III

How does this…

…cause this?

(No question—continue when ready)
When someone with an intact oculomotor system adducts their eye, innervation is increased to the medial rectus (as it should be) and decreased to the lateral rectus (also as it should be). However, in a Duane’s pt CN3 innervates the LR, so when she attempts to adduct her eye, innervation is increased to both the medial rectus and the aberrantly- innervated lateral rectus, so the eye doesn’t adduct. And when two muscles on opposite sides of the eye contract simultaneously, the net result will be that the eye is pulled back, ie, it retracts.

(No question—continue when ready)

**Briefly, what is Duane syndrome?**
A motility disorder with the following key findings:
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**What is the cause?**
The nucleus for cranial nerve VI is missing, and the lateral rectus is innervated by cranial nerve III.
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When someone with an intact oculomotor system adducts their eye, innervation is increased to the medial rectus (as it should be) and decreased to the lateral rectus (also as it should be). However, in a Duane’s pt CN3 innervates the LR, so when she attempts to adduct her eye, innervation is increased to both the medial rectus and the aberrantly-innervated lateral rectus, so the eye doesn’t adduct. And when two muscles on opposite sides of the eye contract simultaneously, the net result will be that the eye is pulled back, ie, it retracts. Further, if this co-contraction is sufficiently vigorous, one or the other rectus muscle might ‘slip’ upwards or downwards, causing the eye to up- or downshoot respectively.

Duane syndrome

Briefly, what is Duane syndrome?
A motility disorder with the following key findings:
-- At least some limitation of horizontal movement
-- Attempted adduction causes the globe to retract, and may cause it to up- or downshoot

What is the cause?
The nucleus for cranial nerve VI is missing, and the lateral rectus is innervated by cranial nerve III.
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**Duane syndrome**

Briefly, what is Duane syndrome?
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The nucleus for cranial nerve VI is missing, and the lateral rectus is innervated by cranial nerve III.

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When someone with an intact oculomotor system adducts their eye, innervation is increased to the medial rectus (as it should be) and decreased to the lateral rectus (also as it should be). However, in a Duane’s pt CN3 innervates the LR, so when she attempts to adduct her eye, innervation is increased to both medial and lateral rectus, so the eye cannot adduct and retracts instead, if this co-contraction occurs downward, causing the eye to upshoot. What is Duane syndrome? A motility disorder with the following key findings:

---

**Duane syndrome**

Briefly, what is Duane syndrome?

A motility disorder with the following key findings:

---

*At least some limitation of horizontal movement*

*Attempted adduction causes the globe to retract*, and may cause it to *up- or downshoot*

How does this...?

What is the cause?

The nucleus for cranial nerve VI is missing, and the lateral rectus is innervated by cranial nerve III.

This finding—*that increased innervation to an agonist muscles is accompanied by a simultaneous decrease in innervation to its antagonist—is ubiquitous to have been ratified into law. What is the eponymous name of the law of ‘reciprocal innervation’?**

**Sherrington’s law.** You should note that Duane syndrome is an exception to Sherrington’s law (this is noteworthy because it would make a good OKAP question).

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Briefly, what is Duane syndrome?

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How does this...?

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The nucleus for cranial nerve VI is missing, and the lateral rectus is innervated by cranial nerve III.

This finding—*that increased innervation to an agonist muscles is accompanied by a simultaneous decrease in innervation to its antagonist—is ubiquitous to have been ratified into law. What is the eponymous name of the law of ‘reciprocal innervation’?**

**Sherrington’s law.** You should note that Duane syndrome is an exception to Sherrington’s law (this is noteworthy because it would make a good OKAP question).
Define *Brown syndrome*: **Deficient elevation in adduction**

2° to restriction of the SO tendon at the trochlea

Is *Brown syndrome* more common in... 
...males or females? Males
...OD or OS? OD

What other two entities could produce restriction of elevation in adduction?
1)
2)

What clinical exam finding must be present if one is to make the diagnosis of *Brown syndrome*?

Forced ductions testing must be positive (i.e., indicate restriction)

But forced ductions are positive in IR restriction as well—how can the two conditions be differentiated?

By retropulsing the globe while performing forced ductions. In IR restriction, retropulsion takes the muscle off stretch, thereby rendering forced ductions 'less positive.' In contrast, retropulsion places the SO tendon on stretch, and thus retropulsion will render the forced ductions 'more positive' in Brown syndrome. The reverse is true if the globe is anteropulsed (pulled forward) prior to performing forced ductions.
Define Brown syndrome: **Deficient elevation in adduction**

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Is Brown syndrome more common in... males or females? Males... OD or OS? OD

What other two entities could produce restriction of elevation in adduction?
1) IR restriction
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Vertical Deviations

**Define Brown syndrome:**
*Deficient elevation in adduction*

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What other two entities could produce restriction of elevation in adduction?
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What clinical exam finding **must** be present if one is to make the diagnosis of Brown syndrome?

Forced ductions testing must be positive (i.e., indicate restriction). In addition to restricted elevation, what else occurs during adduction in Brown syndrome?

--The palpebral fissure widens
--The eye may involuntarily depress (called downshoot)

What other two entities could produce restriction of elevation in adduction?
1) IR restriction
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Vertical Deviations

Define Brown syndrome: Deficient elevation in adduction due to restriction of the SO tendon at the trochlea.

Is Brown syndrome more common in... males or females? Males
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What other two entities could produce restriction of elevation in adduction?
1) IR restriction
2) IO palsy

What clinical exam finding must be present if one is to make the diagnosis of Brown syndrome?
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**Vertical Deviations**

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Vertical Deviations

Define Brown syndrome: **Deficient elevation in adduction** to restriction of the SO tendon at the trochlea

Is Brown syndrome more common in... males or females? **Males**...OD or OS? **OD**

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Vertical Deviations

2° to oblique dysfunction

Superior

Inferior

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Vertical Deviations

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Differentiating Brown syndrome from IO palsy

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2° to oblique dysfunction

Superior

Deficient elevation in adduction

Brown syndrome:

- Deficient elevation in adduction
- 2° to restriction of the SO tendon at the trochlea

Is Brown syndrome more common in...

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What other two entities could produce restriction of elevation in adduction?

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What common strabismus syndrome has the opposite pattern (i.e., is more common in.

...females and left eyes)? Duane syndrome

Name three causes of trochlear restriction:

- Idiopathic
- Traumatic
- Inflammatory

What else occurs during adduction in Brown syndrome?

- The palpebral fissure widens
- The eye may involuntarily depress (called downshoot)

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Vertical Deviations

**Brown syndrome**

- **Definition:** Deficient elevation in adduction
- **Cause:** Restricted movement of the SO tendon at the trochlea

**Questions**

- Is Brown syndrome more common in males or females?
- OD or OS?

**Other Entities**

1. IR restriction
2. IO palsy

**Differentiating Brown syndrome from IO palsy**

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**Clinical Exam**

- Forced ductions testing must be positive (i.e., indicate restriction)
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**Vertical Deviations**

**Define Brown syndrome:**
- **Deficient elevation in adduction**
- Due to restriction of the SO tendon at the trochlea

**Is Brown syndrome more common in...**
- Males
- OD or OS? OD

What common strabismus syndrome has the opposite pattern (i.e., is more common in females and left eyes)?
- Duane syndrome

**Name three causes of trochlear restriction:**
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In addition to restricted elevation, what else occurs during adduction in Brown syndrome?
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**Differentiating Brown syndrome from IO palsy**

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**Vertical Deviations**

Define Brown syndrome:
- **Deficient elevation in adduction**
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Is Brown syndrome more common in... 
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What common strabismus syndrome has the opposite pattern (i.e., is more common in females and left eyes)?
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Name three causes of trochlear restriction:
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What other two entities could produce restriction of elevation in adduction?
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Differentiating Brown syndrome from IO palsy

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**Table:**

- **Brown Syndrome**
  - Positive
  - V pattern

---

**Diagram:**

- Superior
- Inferior
- Infer: What common strabismus syndrome has the opposite pattern (i.e., is more common in females and left eyes)?
  - Duane syndrome

**Legend:**

- IR restriction
- IO palsy
- SO overaction
- Forced ductions
- Strabismus pattern
- SO overaction
Vertical Deviations

Define Brown syndrome:
Deficient elevation in adduction
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Forced ductions testing must be positive (i.e., indicate restriction)

But forced ductions are positive in IR restriction as well—how can the two conditions be differentiated?
By retropulsing the globe while performing forced ductions. In IR restriction, retropulsion takes the muscle off stretch, thereby rendering forced ductions ‘less positive.’ In contrast, retropulsion places the SO tendon on stretch, and thus retropulsion will render the forced ductions ‘more positive’ in Brown syndrome. The reverse is true if the globe is anteropulsed (pulled forward) prior to performing forced ductions.

Differentiating Brown syndrome from IO palsy

<table>
<thead>
<tr>
<th></th>
<th>Forced ductions?</th>
<th>Strabismus pattern?</th>
<th>SO overaction?</th>
</tr>
</thead>
<tbody>
<tr>
<td>IO Palsy</td>
<td>Negative</td>
<td>A pattern</td>
<td>Present</td>
</tr>
<tr>
<td>Brown Syndrome</td>
<td>Positive</td>
<td>V pattern</td>
<td>Absent</td>
</tr>
</tbody>
</table>

211
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)
  - Overaction
  - Palsy
  - Brown syndrome

Inferior Oblique (IO)

Uncertain mechanism

Brown syndrome: Management
-- In acute-onset cases, image... [2 locations]
Vertical Deviations

Brown syndrome: Management
--In acute-onset cases, image…sinuses & orbits

2° to oblique dysfunction

Uncertain mechanism

Superior Oblique (SO)

Overaction

Palsy

Brown syndrome

Inferior Oblique (IO)
Vertical Deviations

Axial STIR (A) and postcontrast fat-saturated T1 (B) images; coronal STIR (C) and postcontrast fat-saturated T1 (D) images. There is subtle increased STIR signal and mild asymmetric thickening in anterior portion of the left superior oblique tendon. On postcontrast imaging, there is prominent enhancement around the trochlea region (B and D, indicated by the arrows).

Acute Brown syndrome
Vertical Deviations

Brown syndrome: Management
--In acute-onset cases, image…sinuses & orbits
--Consider…[drug]
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

Brown syndrome

Inferior Oblique (IO)

Uncertain mechanism

Brown syndrome: Management
--In acute-onset cases, image…sinuses & orbits
--Consider… steroids (systemic and/or local)
Brown syndrome: Management

--In acute-onset cases, image sinuses & orbits
--Consider steroids (systemic and/or local)
--If present, treat systemic inflammatory disease
--Consider surgery only if hypotropic in primary gaze

Vertical Deviations

2° to oblique dysfunction

Uncertain mechanism

Superior Oblique (SO)

Inferior Oblique (IO)

Overaction

Palsy

Brown syndrome
Brown syndrome: Management

- In acute-onset cases, image sinuses & orbits
- Consider steroids (systemic and/or local)
- If present, treat systemic inflammatory disease

Uncertain mechanism

2° to oblique dysfunction

Superior Oblique (SO)
- Overaction
- Palsy
- Brown syndrome

Inferior Oblique (IO)
**Brown syndrome: Management**
-- In acute-onset cases, image sinuses & orbits
-- Consider steroids (systemic and/or local)
-- If present, treat systemic inflammatory disease
-- Consider surgery only if [specific strabismic problem]
Vertical Deviations

2° to oblique dysfunction

- Superior Oblique (SO)
- Inferior Oblique (IO)

Uncertain mechanism

Brown syndrome: Management
-- In acute-onset cases, image sinuses & orbits
-- Consider steroids (systemic and/or local)
-- If present, treat systemic inflammatory disease
-- Consider surgery only if hypotropia in primary gaze
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)
- Overaction
- Palsy
- Brown syndrome

Inferior Oblique (IO)
- ?
- ?

Uncertain mechanism
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)
- Overaction
- Palsy
- Brown syndrome

Inferior Oblique (IO)
- Overaction
- Palsy

Uncertain mechanism
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)
- Overaction
- Palsy
- Brown syndrome

Inferior Oblique (IO)
- Overaction
- Palsy

Uncertain mechanism

IO Overaction
--Eye elevates in…[position]
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)
- Overaction
- Palsy
- Brown syndrome

Inferior Oblique (IO)
- Overaction
- Palsy

IO Overaction
--Eye elevates in…adduction

Uncertain mechanism
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)
- Overaction
- Palsy
- Brown syndrome

Inferior Oblique (IO)
- Overaction
- Palsy

IO Overaction
--Eye elevates in...adduction
--Develops in % of congenital ET cases

Uncertain mechanism
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)
- Overaction
- Palsy
- Brown syndrome

Inferior Oblique (IO)
- Overaction
- Palsy

IO Overaction
-- Eye elevates in adduction
-- Develops in ~2/3 of congenital ET cases

Uncertain mechanism
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)
- Overaction
- Palsy
- Brown syndrome

Inferior Oblique (IO)
- Overaction
- Palsy

IO Palsy
--[How common?]
Vertical Deviations

2° to oblique dysfunction

- Superior Oblique (SO)
  - Overaction
  - Palsy
  - Brown syndrome

- Inferior Oblique (IO)
  - Overaction
  - Palsy

IO Palsy -- Uncommon

Uncertain mechanism
Vertical Deviations

2° to oblique dysfunction

- Superior Oblique (SO)
  - Overaction
  - Palsy
  - Brown syndrome

- Inferior Oblique (IO)
  - Overaction
  - Palsy

IO Palsy
--Uncommon
--Etiology uncertain
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)
- Overaction
- Palsy
- Brown syndrome

Inferior Oblique (IO)
- Overaction
- Palsy

Uncertain mechanism

IO Palsy
- Uncommon
- Etiology uncertain
- Clinically similar to... strabismic entity
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)
- Overaction
- Palsy
- Brown syndrome

Inferior Oblique (IO)
- Overaction
- Palsy

IO Palsy
-- Uncommon
-- Etiology uncertain
-- Clinically similar to... SO overaction (can be a difficult differentiation)

Uncertain mechanism
Vertical Deviations

- Superior Oblique (SO)
  - Overaction
  - Palsy
  - Brown syndrome

- Inferior Oblique (IO)
  - Overaction
  - Palsy

Uncertain mechanism
Vertical Deviations

- 2° to oblique dysfunction
  - Superior Oblique (SO)
    - Overaction
    - Palsy
    - Brown syndrome
  - Inferior Oblique (IO)
    - Overaction
    - Palsy
- Uncertain mechanism
  - Double Elevator Palsy
  - DVD
Vertical Deviations

2° to oblique dysfunction

- Superior Oblique (SO)
- Inferior Oblique (IO)

Uncertain mechanism

- Double Elevator Palsy
- DVD

*Double Elevator Palsy*

--aka…
Vertical Deviations

- **Vertical Deviations**
  - 2° to oblique dysfunction
    - Superior Oblique (SO)
    - Inferior Oblique (IO)
  - Uncertain mechanism
    - Double Elevator Palsy
    - DVD

*Double Elevator Palsy*
--aka... *Monocular Elevation Deficiency*
Vertical Deviations

Double elevator palsy
Vertical Deviations

2° to oblique dysfunction

- Superior Oblique (SO)
- Inferior Oblique (IO)

Uncertain mechanism

- Double Elevator Palsy
- DVD

**Double Elevator Palsy**
- *aka* Monocular Elevation Deficiency
- *Catch-all term for a strabismus involving* [basic problem]
**Vertical Deviations**

- **2° to oblique dysfunction**
  - Superior Oblique (SO)
  - Inferior Oblique (IO)

- **Uncertain mechanism**
  - Double Elevator Palsy
  - DVD

**Double Elevator Palsy**
- *aka* Monocular Elevation Deficiency
- Catch-all term for a strabismus involving... decreased elevation in all fields of gaze
  - Often adopt a... chin-up position
  - 50% have... concomitant ptosis (1/3 of these with... Marcus-Gunn jaw wink)
Vertical Deviations

2º to oblique dysfunction

- Superior Oblique (SO)
- Inferior Oblique (IO)

Uncertain mechanism

- Double Elevator Palsy
- DVD

Double Elevator Palsy
- aka... Monocular Elevation Deficiency
- Catch-all term for a strabismus involving... decreased elevation in all fields of gaze
- Due to... [two explanations]
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)  Inferior Oblique (IO)

Uncertain mechanism

Double Elevator Palsy

--aka...Monocular Elevation Deficiency
--Catch-all term for a strabismus involving...decreased elevation in all fields of gaze
--Due to...restriction or elevation insufficiency (or both)
Vertical Deviations

**Uncertain mechanism**

Differentiating between IR restriction and elevator insufficiency as the cause of a double elevator palsy

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<tr>
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<th>Inferior Restriction</th>
<th>Elevator Insufficiency</th>
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Double Elevator Palsy

DVD

Catch all term for a strabismus involving decreased elevation in all fields of gaze

--Due to...restriction or elevation insufficiency (or both)
### Vertical Deviations

Differential diagnosis of vertical deviations:

<table>
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<tr>
<th>Cause</th>
<th>Forced Ductions?</th>
<th>Inferior Restriction</th>
<th>Elevator Insufficiency</th>
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<tbody>
<tr>
<td>Double Elevator Palsy</td>
<td>Positive</td>
<td>Positive</td>
<td>Negative</td>
</tr>
<tr>
<td>DVD</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Differentiating between IR restriction and elevator insufficiency as the cause of a double elevator palsy**

- **Uncertain mechanism**
- **Inferior Restriction**
  - Forced Ductions: Positive
- **Elevator Insufficiency**
  - Forced Ductions: Negative

**DVD**

- Catch-all term for a strabismus involving decreased elevation in all fields of gaze

-- Due to... restriction or elevation insufficiency (or both)
**Vertical Deviations**

**Uncertain mechanism**

Differentiating between IR restriction and elevator insufficiency as the cause of a double elevator palsy

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<td>Negative</td>
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**Double Elevator Palsy** -- aka Monocular Elevation Deficiency -- Catch-all term for a strabismus involving decreased elevation in all fields of gaze

--Due to...restriction or elevation insufficiency (or both)
Vertical Deviations

**Uncertain mechanism**

- **Double Elevator Palsy**
  - **DVD**

Differentiating between IR restriction and elevator insufficiency as the cause of a double elevator palsy

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<td>Negative</td>
<td>Reduced</td>
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Catch-all term for a strabismus involving decreased elevation in all fields of gaze --Due to...restriction or elevation insufficiency (or both)
**Vertical Deviations**

**Differentiating between IR restriction and elevator insufficiency as the cause of a double elevator palsy**

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</table>

**Uncertain mechanism**

**Double Elevator Palsy**

**DVD**

Catch-all term for a strabismus involving decreased elevation in all fields of gaze.

--Due to... **restriction or elevation insufficiency (or both)**
Vertical Deviations

Uncertain mechanism

Differentiating between IR restriction and elevator insufficiency as the cause of a double elevator palsy

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--Double Elevator Palsy

--Catch all term for a strabismus involving decreased elevation in all fields of gaze

--Due to…restriction or elevation insufficiency (or both)

DVD
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)
Inferior Oblique (IO)

Uncertain mechanism

Double Elevator Palsy

--aka...Monocular Elevation Deficiency
--Catch-all term for a strabismus involving...decreased elevation in all fields of gaze
--Due to...restriction or elevation insufficiency (or both)
--Presents with...
Vertical Deviations

**Double Elevator Palsy**
--aka **Monocular Elevation Deficiency**
--Catch-all term for a strabismus involving...decreased elevation in all fields of gaze
--Due to...restriction or elevation insufficiency (or both)
--Presents with...hypotropia that worsens in upgaze
Vertical Deviations

2º to oblique dysfunction

- Superior Oblique (SO)
- Inferior Oblique (IO)

Uncertain mechanism

- Double Elevator Palsy

Double Elevator Palsy
--aka…Monocular Elevation Deficiency
--Catch-all term for a strabismus involving…decreased elevation in all fields of gaze
--Due to…restriction or elevation insufficiency (or both)
--Presents with…hypotropia that worsens in upgaze
--Often adopt a…[head position]

DVD
**Vertical Deviations**

2° to oblique dysfunction

- Superior Oblique (SO)
- Inferior Oblique (IO)

Uncertain mechanism

- Double Elevator Palsy
- DVD

**Double Elevator Palsy**

--aka…**Monocular Elevation Deficiency**
--Catch-all term for a strabismus involving…decreased elevation in all fields of gaze
--Due to…restriction or elevation insufficiency (or both)
--Presents with…hypotropia that worsens in upgaze
--Often adopt a…chin-up position
Vertical Deviations

2° to oblique dysfunction

- Superior Oblique (SO)
- Inferior Oblique (IO)

Uncertain mechanism

- Double Elevator Palsy
- DVD

**Double Elevator Palsy**
- *aka*...Monocular Elevation Deficiency
- Catch-all term for a strabismus involving...decreased elevation in all fields of gaze
- Due to...restriction or elevation insufficiency (or both)
- Presents with...hypotropia that worsens in upgaze
- Often adopt a...chin-up position
- 50% have...[another EOM problem]
Vertical Deviations

2° to oblique dysfunction

- Superior Oblique (SO)
- Inferior Oblique (IO)

Uncertain mechanism

- Double Elevator Palsy
- DVD

**Double Elevator Palsy**

- *aka…Monocular Elevation Deficiency*
- Catch-all term for a strabismus involving...decreased elevation in all fields of gaze
- Due to...restriction or elevation insufficiency (or both)
- Presents with...hypotropia that worsens in upgaze
- Often adopt a...chin-up position
- 50% have...concomitant ptosis (1/3 of these with...[eponymous condition])
Vertical Deviations

2° to oblique dysfunction

- Superior Oblique (SO)
- Inferior Oblique (IO)

Uncertain mechanism

- Double Elevator Palsy
- DVD

**Double Elevator Palsy**
-- *aka*... **Monocular Elevation Deficiency**
-- Catch-all term for a strabismus involving... decreased elevation in all fields of gaze
-- Due to... restriction or elevation insufficiency (or both)
-- Presents with... hypotropia that worsens in upgaze
-- Often adopt a... chin-up position
-- 50% have... concomitant ptosis (1/3 of these with... Marcus-Gunn jaw wink)
Broadly speaking, what sort of disorder is Marcus-Gunn jaw wink (MGJW)?
Vertical Deviations

Broadly speaking, what sort of disorder is Marcus-Gunn jaw wink (MGJW)?
It is one of synkinesis.

2° to oblique dysfunction:
- Superior Oblique (SO)
- Inferior Oblique (IO)

Double Elevator Palsy
--aka…Monocular Elevation Deficiency
--Catch-all term for a strabismus involving decreased elevation in all fields of gaze
--Due to…restriction or elevation insufficiency (or both)
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Broadly speaking, what sort of disorder is Marcus-Gunn jaw wink (MGJW)?
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What does synkinesis refer to?

Double Elevator Palsy
--aka…Monocular Elevation Deficiency
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Vertical Deviations

Broadly speaking, what sort of disorder is Marcus-Gunn jaw wink (MGJW)?
It is one of synkinesis

What does synkinesis refer to?
The involuntary movement of one body part in response to the voluntary movement of another

Double Elevator Palsy
--aka...Monocular Elevation Deficiency
--Catch-all term for a strabismus involving decreased elevation in all fields of gaze
--Due to...restriction or elevation insufficiency (or both)
--Presents with...hypotropia that worsens in upgaze
--Often adopt a...chin-up position
--50% have...concomitant ptosis (1/3 of these with...Marcus-Gunn jaw wink)
**Vertical Deviations**

Broadly speaking, what sort of disorder is Marcus-Gunn jaw wink (MGJW)?

It is one of **synkinesis**

*What does synkinesis refer to?*

The **involuntary** movement of one bodypart in response to the **voluntary** movement of another

*Is the ptosis of MGJW unilateral, or bilateral?*

**Double Elevator Palsy**

--aka…Monocular Elevation Deficiency
--Catch-all term for a strabismus involving decreased elevation in all fields of gaze
--Due to restriction or elevation insufficiency (or both)
--Presents with hypotropia that worsens in upgaze
--Often adopt a chin-up position
--50% have concomitant ptosis (1/3 of these with Marcus-Gunn jaw wink)
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

Inferior Oblique (IO)

Ocular Overaction

Ocular Underaction

Double Elevator Palsy

--aka…Monocular Elevation Deficit

--Catch-all term for a strabismus involving decreased elevation in all fields of gaze

--Due to…restriction or elevation insufficiency (or both)

--Presents with…hypotropia that worsens in upgaze

--Often adopt a…chin-up position

--50% have…concomitant ptosis (1/3 of these with…Marcus-Gunn jaw wink)

Broadly speaking, what sort of disorder is Marcus-Gunn jaw wink (MGJW)?

It is one of synkinesis

What does synkinesis refer to?

The involuntary movement of one bodypart in response to the voluntary movement of another

Is the ptosis of MGJW unilateral, or bilateral?

Unilateral

Marcus-Gunn jaw wink
Double Elevator Palsy
-aka... Monocular Elevation Deficit
--DVD
--aka... Monocular Elevation Deficit
--Catch-all term for a strabismus involving decreased elevation in all fields of gaze
--Due to... restriction or elevation insufficiency (or both)
--Presents with... hypotropia that worsens in upgaze
--Often adopt a... chin-up position
--50% have... concomitant ptosis (1/3 of these with... Marcus-Gunn jaw wink)

2° to oblique dysfunction
Superior Oblique (SO)
Inferior Oblique (IO)

Broadly speaking, what sort of disorder is Marcus-Gunn jaw wink (MGJW)?
It is one of synkinesis.
What does synkinesis refer to?
The involuntary movement of one bodypart in response to the voluntary movement of another.
Is the ptosis of MGJW unilateral, or bilateral?
Is the clinical hallmark of MGJW?
The involuntary movement of one bodypart in response to the voluntary movement of another.

Marcus-Gunn jaw wink

What is the ptosis of MGJW unilateral, or bilateral?
What does synkinesis refer to?

Marcus-Gunn jaw wink

-50% have... concomitant ptosis (1/3 of these with... Marcus-Gunn jaw wink)

20° to oblique dysfunction
Superior Oblique (SO)
Inferior Oblique (IO)

2° to oblique dysfunction
Superior Oblique (SO)
Inferior Oblique (IO)
Broadly speaking, what sort of disorder is Marcus-Gunn jaw wink (MGJW)?
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What does synkinesis refer to?
The involuntary movement of one body part in response to the voluntary movement of another

Is the ptosis of MGJW unilateral, or bilateral?
Unilateral

What is the clinical hallmark of MGJW?
The ptotic lid elevates in response to voluntary masticatory movements of the jaw
Vertical Deviations
Vertical Deviations

Broadly speaking, what sort of disorder is Marcus-Gunn jaw wink (MGJW)?
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Which jaw movements are involved?

Double Elevator Palsy
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Vertical Deviations

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Is the ptosis of MGJW unilateral, or bilateral?
Unilateral

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Which jaw movements are involved?
--Lateral displacement
--Protrusion
--Wide opening
--Clenching

Marcus-Gunn jaw wink

2° to oblique dysfunction

Superior Oblique (SO) Inferior Oblique (IO)

Overaction

Double Elevator Palsy--aka…Monocular Elevation Deficit--Catch-all term for a strabismus involving decreased elevation in all fields of gaze--Due to…restriction or elevation insufficiency (or both)--Presents with…hypotropia that worsens in upgaze--Often adopt a…chin-up position--50% have…concomitant ptosis (1/3 of these with…Marcus-Gunn jaw wink)
Vertical Deviations

2º to oblique dysfunction

Superior Oblique (SO) Inferior Oblique (IO)

Double Elevator Palsy
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What is the classic story regarding when parents first note their infant has MGJW?
It is while the infant is nursing
**Vertical Deviations**

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Marcus-Gunn jaw wink
Vertical Deviations

Broadly speaking, what sort of disorder is Marcus-Gunn jaw wink (MGJW)?
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An aside: MGJW is a congenital condition in which a cranial nerve (dys)innervates a cranial muscle. What is the general term for such congenital cranial dysinnervation disorders?

Double Elevator Palsy
--aka...Monocular Elevation Deficit
--Catch-all term
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It is while the infant is nursing.

An aside: MGJW is a congenital condition in which a cranial nerve (dys)innervates a cranial muscle. What is the general term for such congenital cranial dysinnervation disorders?
Vertical Deviations

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They are called ‘congenital cranial dysinnervation disorders’

Broadly speaking, what sort of disorder is Marcus-Gunn jaw wink (MGJW)?
It is one of synkinesis

What does synkinesis refer to?
The involuntary movement of one body part in response to the voluntary movement of another

Is the ptosis of MGJW unilateral, or bilateral?
Unilateral

What is the clinical hallmark of MGJW?
The ptotic lid elevates in response to voluntary masticatory movements of the jaw

Which jaw movements are involved?
--Lateral displacement
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Another congenital cranial dysinnervation disorder involving an ophthalmic movement should readily come to mind—what is it?
Duane syndrome, as discussed previously

Marcus-Gunn jaw wink
**Vertical Deviations**

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Another congenital cranial dysinnervation disorder involving an ophthalmic movement should readily come to mind—what is it? Double Elevator Palsy—aka…Monocular Elevation Deficit—Catch-all term—Due to…restriction—Presents with…hypotropia that worsens in upgaze—Often adopt a…chin-up position—50% have…concomitant ptosis (1/3 of these with…Marcus-Gunn jaw wink).

Broadly speaking, what sort of disorder is Marcus-Gunn jaw wink (MGJW)? It is one of synkinesis. What does synkinesis refer to? The involuntary movement of one bodypart in response to the voluntary movement of another.

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Briefly, what is Duane syndrome?

A motility disorder with the following key findings:
--At least some limitation of horizontal movement
--Attempted adduction causes the globe to retract, and may cause it to up- or downshoot

What is the cause?
The nucleus for cranial nerve VI is missing, and the lateral rectus is innervated by cranial nerve III

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If a patient has a double elevator palsy, but Bell’s phenomenon is intact, what can be inferred regarding etiology?
Vertical Deviations

If a patient has a double elevator palsy, but Bell’s phenomenon is intact, what can be inferred regarding etiology? The ‘palsy’ is probably supranuclear in origin.
Vertical Deviations

2° to oblique dysfunction

- Superior Oblique (SO)
  - Overaction
  - Palsy
  - Brown syndrome
- Inferior Oblique (IO)
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Uncertain mechanism

- Double Elevator Palsy
- DVD

**Double Elevator Palsy: Management**

--If IR restricted:
Vertical Deviations

2º to oblique dysfunction

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Double Elevator Palsy

DVD

Double Elevator Palsy: Management
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Vertical Deviations

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Double Elevator Palsy: Management
-- If IR restricted: Recess it
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DVD

What is the Knapp procedure?
Vertical Deviations

2° to oblique dysfunction

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Double Elevator Palsy:
- If IR restricted: Recess it
- If no IR restriction: **Knapp procedure**

Double Elevator Palsy: *Management*

*What is the* Knapp procedure? Relocating the LR and MR insertions toward the SR
Vertical Deviations

Knapp procedure
Vertical Deviations

2° to oblique dysfunction

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Vertical Deviations

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Why is it important to address the ptosis concurrently? You don’t want to elevate an eye behind a ptotic lid—it could lead to amblyopia.
Vertical Deviations

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Why is it important to address the ptosis concurrently? You don’t want to elevate an eye behind a ptotic lid—it could lead to deprivation amblyopia.
In this context, what does DVD stand for?

Dissociated vertical deviation

Who is the typical DVD pt?
A child with infantile/congenital ET or XT

What is the classic clinical finding?
An eye will slowly elevate and extort, either spontaneously (manifest DVD) or when occluded (latent DVD). A crucial finding occurs when the drifting eye reorients downward, and it is this--the fellow eye does not move downward simultaneously (as would normally be the case).
Vertical Deviations

2° to oblique dysfunction

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2° to oblique dysfunction

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Why would it ‘be the case’ that both eyes would move downward simultaneously?

Eye reorients downward, and it is this--the fellow eye does not move downward simultaneously (as would normally be the case).
Vertical Deviations

2° to oblique dysfunction

Uncertain mechanism

Why would it ‘be the case’ that both eyes would move downward simultaneously?
In order to maintain visual cooperation, eye movements are tightly linked—EOMs on each eye are ‘yoked’ to one another to ensure the eyes move in a coordinated fashion. For example, for rightward gaze the right LR and left MR are yoke muscles.

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*How does Hering’s law relate to DVD?*

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How does Hering's law relate to DVD?
As noted, in DVD the downward reorientation movement by the drifting eye is not accompanied by a downward movement of the fellow eye. As the muscles that depress the eyes are yoke muscles, this means that DVD represents a violation of Hering’s law.

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DVD represents a violation of Hering’s law.
Vertical Deviations

2° to oblique dysfunction

Uncertain mechanism

Why would it ‘be the case’ that both eyes would move downward simultaneously?
In order to maintain visual cooperation, eye movements are tightly linked—EOMs on each side are yoked. For example, the right LR and left MR are yoke muscles.

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How does this relate toDVD?
As noted, in DVD the downward reorientation movement by the drifting eye is not accompanied by a downward movement of the fellow eye. As the muscles that depress the eyes are yoke muscles, this means that DVD represents a violation of Hering’s law.

As an aside: Is there such a thing as a dissociated horizontal deviation?

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Vertical Deviations

2º to oblique dysfunction

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For example of motor correspondence:
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As an aside: Is there such a thing as a dissociated horizontal deviation?
A DHD? Indeed there is. There is also a dissociated torsional deviation (DTD).
Together, DVD, DHD and DTD comprise the dissociated strabismus complex.
(All that being said, the only one the Peds book discusses at length is DVD.)

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