Vertical Deviations

Vertical Deviations

?    ?
Vertical Deviations

$2^\circ$ to oblique dysfunction

Uncertain mechanism
Vertical Deviations

Which is the more common cause of vertical deviations?

- $2^\circ$ to oblique dysfunction?
- Uncertain mechanism?
Vertical Deviations

2° to oblique dysfunction

Uncertain mechanism

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

Which is the more common cause of vertical deviations?
- Oblique dysfunction

Do vertical deviations tend to be comitant, or incomitant?
Which is the more common cause of vertical deviations?
Oblique dysfunction

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

2° to oblique dysfunction

Uncertain mechanism

Which is the more common cause of vertical deviations?
Oblique dysfunction

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

*In this context, what does the word *comitant* mean?*
Vertical Deviations

Which is the more common cause of vertical deviations? Oblique dysfunction.

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

In this context, what does the word comitant mean? It means the ‘the same in all fields of gaze’.
Which is the more common cause of vertical deviations?
Oblique dysfunction

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

*In this context, what does the word comitant mean?*
It means the ‘the same in all fields of gaze’

*What is spread of comitance?*
Which is the more common cause of vertical deviations?
Oblique dysfunction

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

In this context, what does the word comitant mean?
It means the ‘the same in all fields of gaze’

What is spread of comitance?
The neuroadaptive process in which a longstanding palsy gradually transforms from incomitant to comitant (ie, becomes similar in all fields of gaze)
Vertical Deviations

2° to oblique dysfunction

Uncertain mechanism

?
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

Inferior Oblique (IO)

Uncertain mechanism
Vertical Deviations

2° to oblique dysfunction

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

Uncertain mechanism

?
Vertical Deviations

2° to oblique dysfunction

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

- Inferior Oblique (IO)
  - Uncertain mechanism
What is the classic exam finding in SO overaction?

Superior Oblique (SO)

Overaction
- Palsy
- Brown syndrome
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

Overaction
- Palsy
- Brown syndrome

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

Uncertain mechanism
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?

Brown syndrome

Overaction

Palsy

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 unilateral or asymmetric

Uncertain mechanism

Palsy

Brown syndrome
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

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

Will vertical misalignment be present in primary gaze?
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Palsy

Brown syndrome

Uncertain mechanism
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

- Overaction
  - Palsy
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Uncertain mechanism

What is the classic exam finding in SO overaction?
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What is the surgical treatment for SO overaction?
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

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Tenotomy vs silicone expander

Uncertain mechanism
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

Overaction
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Tenotomy vs silicone expander

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

What is the surgical treatment for SO overaction?
Tenotomy vs silicone expander

Why are surgeons reluctant to operate on a patient with bifixation?
Surgery could result in 'direction' diplopia
**Vertical Deviations**

2° to oblique dysfunction

Superior Oblique (SO)

- Overaction
- Palsy
- Brown syndrome

Uncertain mechanism

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 unilateral or asymmetric

What is the surgical treatment for SO overaction? Tenotomy 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)

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)

Uncertain mechanism

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

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?

Palsy

Overaction
Brown syndrome
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?
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)
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Upon encountering a SO palsy, what question must you consider forthwith?
Vertical Deviations

What is the classic exam finding in SO palsy?
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 forthwith?
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
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**Superior Oblique (SO)**

**Inferior Oblique**

2° to oblique dysfunction

**Palsy**

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**Brown syndrome**
Vertical Deviations

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2° to oblique dysfunction

Superior Oblique (SO)

Inferior Oblique

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Overaction

**Palsy**

Brown syndrome
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2° to oblique dysfunction

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

2° to oblique dysfunction

Superior Oblique (SO)  Inferior Oblique

Regarding SO palsy: As a general rule:
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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)
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.)
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That it's not in fact an asymmetric bilateral SO palsy

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

Regarding SO palsy: As a general rule:
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Briefly, to what does the term vertical fusional amplitudes refer?
It refers to the amount of vertical prism a pt can take before fusion breaks down

Brown syndrome
Vertical Deviations

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2° to oblique dysfunction

Superior
Oblique (SO)

Inferior
Oblique (IO)

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As an aside—how large are normal **horizontal fusional amplitudes**?
Vertical Deviations

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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**

As an aside—how large are normal **horizontal fusional amplitudes**?
Much larger--in the 10-15 prism diopter range
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

How can you confirm that a SO palsy is congenital?
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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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What is the most common cause of acquired SO palsy?
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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?
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**What is the most common cause of acquired SO palsy?**
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A lot more—in the 12-15 prism diopter range
**Vertical Deviations**

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

**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?**

---

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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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

2° to oblique dysfunction

Superior Oblique (SO)

 Inferior Oblique (IO)


Palsy

Brown syndrome

Overaction

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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

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For this reason, it is absolutely vital that one establish with certainty the uni- vs bilaterality of SO palsy!

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?

Why should you care whether a palsy is unilateral vs bilateral?
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When diagnosing a unilateral SO palsy, what must you be sure to rule out?
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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 process until proven otherwise!

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:
--congenital SO palsy is much more likely to be **unilateral**
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What is the most common cause of acquired SO palsy?

Closure 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 little as 0°)

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

<table>
<thead>
<tr>
<th>V-pattern ET present?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unilateral</strong> SO palsy</td>
</tr>
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<td>yes or no</td>
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**Key Findings in Uni- vs Bilateral SO Palsy**

- **Unilateral** SO palsy
- **Bilateral** SO palsy

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<tr>
<th><strong>Superior Oblique (SO)</strong></th>
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Regarding SO palsy: As a general rule:
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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)

Key Findings in Uni- vs Bilateral SO Palsy

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2° to oblique dysfunction

Superior Oblique (SO)   Inferior Oblique

Palsy

Overaction

Brown syndrome

60
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

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<tbody>
<tr>
<td><strong>Unilateral SO palsy</strong></td>
<td>No</td>
<td>Always less than [degrees]</td>
</tr>
<tr>
<td><strong>Bilateral SO palsy</strong></td>
<td>Yes</td>
<td>May be more than [degrees]</td>
</tr>
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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?
- No

How much excyclotorsion on double Maddox rod testing?
- Always less than

Head-tilt test?
- Unilateral SO palsy: No
- Bilateral SO palsy: Yes
## 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

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

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<tr>
<td>SO palsy</td>
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- Unilateral SO palsy
- Bilateral SO palsy

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

---
### Vertical Deviations

**Superior Oblique (SO) palsy**

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

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### What is double Maddox rod testing?

I’m glad you asked…

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**Notes:**

- 2° to oblique dysfunction
- Overaction
- Brown syndrome
- Palsy
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.

Ok, so 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.)

How can double-Maddox rods be used to measure the amount of cyclotorsion?

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

Maddox rod
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Vertical Deviations

Sometimes a clear Maddox rod is used for one eye

Double Maddox rod setup
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Vertical Deviations

Double Maddox rod test in individual without strabismus
**Vertical Deviations**

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Vertical Deviations

Double Maddox rod test in individual with a right SO palsy
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**Vertical Deviations**

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How can the size of the excyclotorsion be used to differentiate between unilateral and bilateral SO palsies?
Vertical Deviations

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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 [#] deg. Thus, if more than this amount is present, bilateral palsies **must** be present.
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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. Thus, if more than this amount is present, bilateral palsies must be present.
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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. Thus, when the pt’s excyclotorsion is more than 10 deg, bilateral palsies must be present. This means that if less than 10 deg is present, the palsy must be unilateral, right? Slow ya roll. 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. Therefore, if the line produced by both rods is perceived as parallel, this means that if less than 10 deg is present, the palsy must be unilateral, right?
Slow ya roll. 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.
All that said, it is very unusual for a bilateral SO palsy to present with less than 5 deg of torsion.
Vertical Deviations

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The maximum amount of excyclotorsion that can result from unilateral SO palsy is 10 deg. Therefore, the difference in orientation of the line perceived by the two eyes cannot exceed 10 deg.

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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
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

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What is the most common cause of acquired SO palsy?
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When diagnosing a 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

When diagnosing a 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

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When diagnosing a 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

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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

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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)

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

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
No
Always less than 10°
Positive to one side only

Bilateral SO palsy
Yes
May be more than 10°
Positive to both sides
**Vertical Deviations**

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Unilateral 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 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).
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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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Vertical Deviations

Left SO palsy: Positive head tilt test
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Vertical Deviations

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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. So for example, when the head is tilted to the right, to stay upright the right eye will in-cyclotort (ie, the superior pole will tort toward the midline), while the left eye will in-cyclotort (ie, the superior pole will tort toward the midline). 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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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

2° to oblique dysfunction

Superior Oblique (SO)

- Overaction
- Palsy

Inferior Oblique (IO)

- Palsy

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

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

Uncertain mechanism
Vertical Deviations

2° to oblique dysfunction

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

Inferior Oblique (IO)

Uncertain mechanism

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

Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

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Inferior Oblique (IO)

Uncertain mechanism

Overaction

Palsy

Brown syndrome

**Wha? Why perform contralateral IR recession for unilateral SO palsy?**
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

Inferior Oblique (IO)

Brown syndrome

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

2° to oblique dysfunction

Superior Oblique (SO)  Inferior Oblique (IO)

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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)

Overaction

Palsy

Brown syndrome

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

2° to oblique dysfunction

Superior Oblique (SO)

- Overaction
- Palsy
- Brown syndrome

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 <15Δ: IO weakening procedure

Management of bilateral SO palsy:
-- Main c/o is torsional diplopia: Harada-Ito procedure
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

- Overaction

Palsy

Brown syndrome

Inferior Oblique (IO)

Management of unilateral SO palsy:

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  **IO weakening procedure**

-- If IO overaction is present and the deviation is >15°: [surgery]
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

- Bony syn./overaction
- Palsy

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°: **IO weakening procedure**
- If IO overaction is present and the deviation is >15°: **Perform both**

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

2° to oblique dysfunction

Uncertain mechanism

Superior Oblique (SO)

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Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

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2° to oblique dysfunction

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Briefly, what is the Harada-Ito procedure?

Harada-Ito procedure
Brown syndrome

Vertical Deviations

2° to oblique dysfunction

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Inferior Oblique (IO)

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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

2° to oblique dysfunction

Superior Oblique (SO)

- Overaction
- Palsy
- Brown syndrome

Inferior Oblique (IO)

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: Harada-Ito procedure
Vertical Deviations

Harada-Ito procedure
Vertical Deviations

$2^\circ$ to oblique dysfunction

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

Uncertain mechanism

- Overaction
- Palsy
- Brown syndrome
Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)
Inferior Oblique (IO)

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

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

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

In addition to restricted elevation, what else occurs during adduction in Brown syndrome?
The palpebral fissure widens
The eye may involuntarily depress (called downshoot)
Define Brown syndrome:
Deficient elevation in adduction 2° to restriction of the SO tendon at the trochlea.

2° to oblique dysfunction

Superior Oblique (SO)

Inferior Oblique

- Overaction
- Palsy

Brown syndrome
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?*
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**

Brown syndrome

Superior Oblique (SO)  
Inferior Oblique

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

2° to oblique dysfunction
Vertical Deviations

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2° to oblique dysfunction

Superior Oblique (SO) Inferior Oblique (IO)

Overaction Palsy

Brown syndrome
Vertical Deviations

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*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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Vertical Deviations

2° to oblique dysfunction

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

Inferior Oblique (IO)

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

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--**Traumatic**
--**Inflammatory**

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

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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)

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
-- Attempted movement causes the globe to up- or downshoot, and may cause it to deviate laterally

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 are three causes of SO restriction at the trochlea:
-- Idiopathic/congenital (i.e., born with a short tendon)
-- Traumatic
-- Inflammatory

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
-- Attempted adduction causes the globe to retract, and may cause it to up- or downshoot
**Define Brown syndrome:**
Deficient elevation in adduction $2^\circ$ 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
-- Attempted adduction causes the globe to retract, and may cause it to up- or downshoot

What is the cause?

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

Name three causes of SO restriction at the trochlea:
-- Idiopathic/congenital (i.e., born with a short tendon)
-- Traumatic
-- Inflammatory
**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
-- 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 lateral rectus is innervated by cranial nerve #
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…
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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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-- 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**

2° to oblique dysfunction

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

---

**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
--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

---

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).

*(No question—continue when ready)*
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
-- 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

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:
--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

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.

**How does this...**

---

Superior Oblique (SO)

Inferior Oblique
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 L-R, so when she attempts to adduct her eye, innervation is increased to the L-R, so the eye retracts. This is due, in part, to simultaneous contraction of the medial recti, which co-contract, causing the eye to up- or downshoot respectively. 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  
--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.  

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.

How does this…

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 (because this factoid would make a good OKAP test question).
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 L.R, so when she attempts to adduct her eye, innervation to the medial rectus, so the eye should retract, and the lateral rectus contracts, causing the eye to up- or downshoot respectively.

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).

**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.
**Vertical Deviations**

2° to oblique dysfunction

Superior

Inferior

**Define Brown syndrome:**

Deficient elevation in adduction

Is Brown syndrome more common in...

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

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

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

2) IO palsy

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.
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**
...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:
- Idiopathic
- 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*)

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?
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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…
...males or females? Males
...OD or OS? OD

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?
Define Brown syndrome:
Deficient elevation in adduction

2° to oblique dysfunction

Superior

Inferior

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

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

**2° to oblique dysfunction:**

Superior

Inferior

**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 trochlear restriction:**
-- Idiopathic
-- 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*)

**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?**
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?**

In addition to restricted elevation, Brown syndrome may also manifest with the following:

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

**Other entities that could produce restriction of elevation in adduction:**
1) IR restriction
2) IO palsy

**Clinical exam finding that must be present for Brown syndrome:**
Forced ductions testing must be positive (i.e., indicate restriction)

**Differentiation from IR restriction:**
- In IR restriction, retropulsion takes the muscle off stretch, rendering forced ductions 'less positive.'
- In Brown syndrome, retropulsion places the SO tendon on stretch, rendering forced ductions 'more positive.'

**Orienting question:**
What other two entities could produce restriction of elevation in adduction?
Define Brown syndrome:
- Deficient elevation in adduction

2° to oblique dysfunction

Superior

Inferior

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 trochlear restriction:
- Idiopathic
- 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)

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?
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.
Define Brown syndrome: Deficient elevation in adduction 2º 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 trochlear restriction: 
-- Idiopathic 
-- Traumatic 
-- Inflammatory

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

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? 
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By retropulsing the globe while performing forced ductions.
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...
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Name three causes of trochlear restriction:
- **Idiopathic**
- **Traumatic**
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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**)

What other two entities could produce restriction of elevation in adduction?
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2) **IO palsy**

What clinical exam finding **must** be present if one is to make the diagnosis of Brown syndrome?
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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.
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 trochlear restriction:
- **Idiopathic**
- **Traumatic**
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In addition to restricted elevation, what else occurs during adduction in Brown syndrome?
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What other two entities could produce restriction of elevation in adduction?
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Vertical Deviations

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

- **2° to restriction of the SO tendon at the trochlea**

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

Uncertain mechanism

Brown syndrome:
- **Overaction Palsy**

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**
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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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<th>Brown Syndrome</th>
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<tr>
<td><strong>Yes</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>No</strong></td>
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**Differentiating Brown syndrome from IO palsy**

**Strabismus pattern?**
- **SO overaction**
- **A pattern**
- **Positive**

**IO Palsy**
- **Negative**
- **A pattern Present**
- **Brown Syndrome**
- **Positive**
- **V pattern Absent**
Vertical Deviations

2° to oblique dysfunction

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 trochlear restriction:
-- Idiopathic
-- Traumatic
-- Inflammatory

In addition to restricted elevation, what else occurs during adduction in Brown syndrome?
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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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Define Brown syndrome:
Deficient elevation in adduction

**2° to oblique dysfunction**

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

**Uncertain mechanism**

**Overaction Palsy**

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**

... 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:

1. **Idiopathic**
2. **Traumatic**
3. **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**)

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

1. IR restriction
2. IO palsy

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**Differentiating Brown syndrome from IO palsy**

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How can Brown syndrome and IO palsy be differentiated?

- Forced ductions?
  - IO Palsy: Negative
  - Brown Syndrome: Positive
- Strabismus pattern?
  - IO Palsy: Present
  - Brown Syndrome: Absent
### Brown Syndrome

**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**
- …OD or OS? **OD**

**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?**

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

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**Differentiating Brown syndrome from IO palsy**

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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 other two entities could produce restriction of elevation in adduction?
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Differentiating Brown syndrome from IO palsy

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**Vertical Deviations**

*Define Brown syndrome:* Deficient elevation in adduction

2° to oblique dysfunction

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

**Uncertain mechanism**

**Overaction Palsy**

Brown syndrome

**Double Elevator Palsy**

**Differentiating Brown syndrome from IO palsy**

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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?**

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**

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

Duane syndrome

**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.

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Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)  Inferior Oblique (IO)

Overaction  Palsy

Brown syndrome

**Brown syndrome: Management**

--In acute-onset cases, image...[2 locations]
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... sinuses & orbits
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

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... [drug]
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... 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...
Brown syndrome: **Management**

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

**Vertebral 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
  - 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... [*specific strabismic problem*]
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

2º 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 17% 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?]

Uncertain mechanism
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

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
-- Clinically similar to... strabismic entity
Vertical Deviations

$2^\circ$ 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

- 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

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

2° to oblique dysfunction

- Superior Oblique (SO)
- Inferior Oblique (IO)
- Double Elevator Palsy
- DVD

Uncertain mechanism

- 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
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...[two explanations]
Vertical Deviations

2º 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

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

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<td></td>
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**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)*

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

Forced inductions? Force generation? Elevation saccades?

Inferior Restriction

Elevator Insufficiency

DVD
Vertical Deviations

**Double Elevator Palsy**
- Also known as 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)

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

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DVD

Uncertain mechanism
Vertical Deviations

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)
Vertical Deviations

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 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)
Vertical Deviations

Uncertain mechanism

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

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

Forced ductions?

Force generation?

Elevation saccades?

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

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

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…hypotropia that worsens in upgaze
**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... *head 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
Vertical Deviations

2° 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... chin-up position
--50% have... [another EOM problem]
Vertical Deviations

2° to oblique dysfunction

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

Uncertain mechanism

- 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

--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)

Overaction

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)?

Marcus-Gunn jaw wink
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)
- 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

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

What does synkinesis refer to?

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)

2° to oblique dysfunction

- Superior Oblique (SO)
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2° to oblique dysfunction

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2° to oblique dysfunction

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

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)?

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What does synkinesis refer to?

The involuntary movement of one body part in response to the voluntary movement of another
Vertical Deviations

2° to oblique dysfunction

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

Uncertain mechanism

Overaction Palsy

Brown syndrome

- 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)?
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?
**Vertical Deviations**

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)
- 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 body part in response to the voluntary movement of another

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

Unilateral
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?

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**

**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)
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- 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)?**
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Unilateral

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**Marcus-Gunn jaw wink**
Vertical Deviations
Vertical Deviations

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Which jaw movements are involved?
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Double Elevator Palsy
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Vertical Deviations

2° to oblique dysfunction

Superior Oblique (SO)

Overaction

Brown syndrome

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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

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
--Protrusion
--Wide opening
--Clenching

Marcus-Gunn jaw wink
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Duane syndrome, as discussed previously

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?
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; i.e., a problem with the cortical ‘elevation center’
Vertical Deviations

2° to oblique dysfunction

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

Inferior Oblique (IO)
- Overaction
- Palsy

Uncertain mechanism

Double Elevator Palsy

Double Elevator Palsy: Management
--If IR restricted:
Vertical Deviations

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- **Double Elevator Palsy**
  - DVD

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

*What is the Knapp procedure?*
Vertical Deviations

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Double Elevator Palsy

DVD

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

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

Knapp procedure
Vertical Deviations

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-- Be sure to address ptosis if present
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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.
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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

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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. Hering’s law of motor correspondence states that yoke muscles receive equal innervation.

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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How does Hering’s law relate to DVD? As noted, in DVD the downward reorientation of the drifting eye is accompanied by a downward movement of the fellow eye. As the muscles that depress the eyes are yoke muscles, this means that a violation of Hering’s law occurs. What is the diagnosis? Another good potential OKAP question, IMO…

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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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How can DVD be explained?
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