Comitant Esotropia

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One useful way to classify esotropia is with respect to comitance. A comitant ET is one in which the magnitude (in prism-diopters) of the esotropia is the same in all fields of gaze. For example, the run-of-the-mill ET typically found in a very young child is usually comitant.

(Prism-diopters are represented by a delta $\Delta$; eg, $50\Delta = 50$ prism-diopters)
Comitant Esotropia

~50° of comitant esotropia
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One useful way to classify esotropia is with respect to *comitance*. A *comitant ET* is one in which the magnitude (in prism-diopters) of the esotropia is the same in all fields of gaze. For example, the run-of-the-mill ET typically found in a very young child is usually comitant. **In contrast, an=incomitant ET** is one in which the magnitude varies among different fields if gaze. The classic cause of an incomitant ET is a CN6 palsy; its magnitude will be greater in gaze to the side of the lesion, and smaller in gaze to the side opposite.
Comitant Esotropia

Huge ET in right gaze  Moderate ET in primary gaze  Almost no ET in left gaze

Incomitant ET 2ndry to right CN6 palsy
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This slide-set will focus on comitant ET. There is no gender predilection for comitant ET; however, there is a racial one: Incidence in White and Black infants is roughly equal, and both are higher than that for infants of Asian descent.
Comitant Esotropia

Congenital (onset < age 6 m)  Acquired (onset > age 6 m)

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It’s important to note here that brief strabismic episodes are commonly seen in the first few (especially two) months of life. Further, it’s not uncommon for the same infant to manifest short periods of both ET and XT; this is referred to as *ocular instability of infancy*. 
This is the first step in how we think about comitant ET: Whether it presented congenitally (defined as before age 6 months) or whether it was acquired (later than age 6 months). Note that *congenital* is a misnomer here in that, technically, a congenital disorder must be present at birth—it can’t show up 6 months later. (For this reason, some clinicians refer to these cases not as ‘congenital,’ but rather as *infantile* esotropia.)

It’s important to note here that brief strabismic episodes are commonly seen in the first few (especially two) months of life. Further, it’s not uncommon for the same infant to manifest short periods of both ET and XT; this is referred to as *ocular instability of infancy*. However, if the ET is 1) present after age 2 months; 2) constant; and/or 3) large, it probably represents a congenital ET.
We divvy congenital ET into two groups:
Those presenting with nystagmus, and
those presenting without it

Comitant Esotropia

Congenital (onset < age 6 m)

Acquired (onset > age 6 m)

With nystagmus  W/o nystagmus
Comitant Esotropia

Congenital (onset < age 6 m)  Acquired (onset > age 6 m)

With nystagmus  W/o nystagmus

**Congenital ET without nystagmus** is your garden-variety ‘my baby’s eyes have been crossed since birth’ esotropia. The deviation tends to be large—30Δ or more. A family history is often present.
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Comitant Esotropia

ET with cross-fixation
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Another common finding in these infants is dissociated vertical deviation (DVD), the phenomenon in which one eye slowly elevates and extorts. This may occur spontaneously (manifest DVD), or only when the eye is occluded (latent DVD).
Comitant Esotropia

(Latent) DVD
Comitant Esotropia

For more on DVD, see slide-set P7 (see also the set concerning Sherrington’s and Hering’s law, FELT3)
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Management of congenital ET w/o nystagmus is usually surgical via bilateral medial rectus recession. It is generally agreed that surgery should occur before the child’s 2\textsuperscript{nd} birthday if possible.
**Comitant Esotropia**

- **Congenital (onset < age 6 m)**
  - **W/o nystagmus**
  - **With nystagmus**

- **Acquired (onset > age 6 m)**

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Comitant Esotropia

Congenital (onset < age 6 m)  Acquired (onset > age 6 m)

With nystagmus  W/o nystagmus

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In order to both prevent diplopia and provide some degree of binocular cooperation, the immature visual system responds to strabismus with some combination of three adaptations:

**Suppression**

**Anomalous retinal correspondence (ARC)**

**Monofixation syndrome**
**Comitant Esotropia**

<table>
<thead>
<tr>
<th>Congenital (onset &lt; age 6 m)</th>
<th>Acquired (onset &gt; age 6 m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W/o nystagmus</td>
<td></td>
</tr>
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- **Suppression** refers to the prevention of an image in one eye from reaching conscious awareness.
- It is one of the three sensory adaptations to strabismus that was mentioned previously.

- **Anomalous retinal correspondence** (ARC) is the development of a common visual direction between noncorresponding locations on the two retinas; eg, in ET the fovea in one eye will ‘align’ with a macular location in the fellow eye that is nasal to its fovea.

- **Monofixation syndrome** is a condition in which the pt develops a combination of a small-angle ET along with a small suppression scotoma.
**Comitant Esotropia**

**Congenital (onset < age 6 m)**
- W/o nystagmus
- **W/ o nystagmus**

**Acquired (onset > age 6 m)**
- With nystagmus

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**Comitant Esotropia**

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- Congenital ET with nystagmus

**Acquired (onset > age 6 m)**

- W/o nystagmus

In order to both prevent diplopia and provide some degree of binocular cooperation, the immature visual system responds to strabismus with some combination of three adaptations:

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Comitant Esotropia

Congenital (onset < age 6 m)  Acquired (onset > age 6 m)

With nystagmus  W/o nystagmus

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For more on sensory adaptations to strabismus, see slide-set P14

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Comitant Esotropia

Congenital (onset < age 6 m)  Acquired (onset > age 6 m)

With nystagmus  W/o nystagmus

Nystagmus refers to involuntary, rhythmic, back-and-forth oscillations of the eyes. The oscillation may be in any plane, including torsional.
Comitant Esotropia

**Congenital (onset < age 6 m)**

- With nystagmus
- W/o nystagmus

**Acquired (onset > age 6 m)**

_Nystagmus_ refers to involuntary, rhythmic, back-and-forth oscillations of the eyes. The oscillation may be in any plane, including torsional. **By definition, a nystagmus starts with a relatively slow drift of the eyes away from their intended position, followed by a corrective movement back towards it.** The corrective move can be fast or slow; if it’s fast the oscillation is called a _jerk_ nystagmus; if slow, a _pendular_ nystagmus. The nature of a nystagmus may change with direction of gaze; ie, a jerk nystagmus may morph into a pendular one in a different field of gaze.
Comitant Esotropia

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For more on nystagmus, see slide-set P4
Comitant Esotropia

Congenital (onset < age 6 m)

With nystagmus
- Nystagmus blockage syndrome
- Latent nystagmus
- Ciancia syndrome

W/o nystagmus

Acquired (onset > age 6 m)

The *Peds/Strabismus* book covers these three forms of congenital ET with nystagmus.
Congenital (onset < age 6 m)  Acquired (onset > age 6 m)

With nystagmus  W/o nystagmus

- Nystagmus blockage syndrome
- Latent nystagmus
- Ciancia syndrome

**Nystagmus blockage syndrome** is the esotropia that develops in pts with *congenital motor nystagmus (CMN).*
Comitant Esotropia

- **Congenital (onset < age 6 m)**
  - With nystagmus
    - Nystagmus blockage syndrome
    - Latent nystagmus
    - Ciancia syndrome
  - W/o nystagmus
- **Acquired (onset > age 6 m)**

*Nystagmus blockage syndrome* is the esotropia that develops in pts with *congenital motor nystagmus (CMN)*. CMN is a form of nystagmus that arises in the first few months of life. Unlike most forms of nystagmus, it is not secondary to either vision loss or CNS pathology— it just kinda ‘is.’
Congenital (onset < age 6 m)  Acquired (onset > age 6 m)

With nystagmus  W/o nystagmus

Nystagmus blockage syndrome is the esotropia that develops in pts with congenital motor nystagmus (CMN). CMN is a form of nystagmus that arises in the first few months of life. Unlike most forms of nystagmus, it is not secondary to either vision loss or CNS pathology— it just kinda ‘is.’ Pts with congenital motor nystagmus usually have pretty good vision (rule of thumb: If a pt has nystagmus + good VA, it’s probably CMN). It is virtually always horizontal.
Comitant Esotropia

Congenital (onset < age 6 m)

Acquired (onset > age 6 m)

With nystagmus

- Nystagmus blockage syndrome
- Latent nystagmus
- Ciancia syndrome

W/o nystagmus

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So why does CMN lead to esotropia? Because early in life, the visual system ‘realizes’ that the nystagmus is minimized (and thus acuity is maximized) when the eyes are converged.
Congenital (onset < age 6 m)  Acquired (onset > age 6 m)

With nystagmus  W/o nystagmus

- Nystagmus blockage syndrome
- Latent nystagmus
- Ciancia syndrome

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So why does CMN lead to esotropia? Because early in life, the visual system ‘realizes’ that the nystagmus is minimized (and thus acuity is maximized) when the eyes are converged. Because of this, the system learns to adopt and maintain an esotropia posture.
**Latent nystagmus** is an interesting phenomenon in which no nystagmus is present when vision is binocular, but commences if/when one eye is occluded.
Comitant Esotropia

Congenital (onset < age 6 m)  Acquired (onset > age 6 m)

With nystagmus  W/o nystagmus

- Nystagmus blockage syndrome
- Latent nystagmus
- Ciancia syndrome

**Ciancia syndrome** has two features that give it away:
The first is, the ET is very large—usually $50^\Delta$ or more.
Second, the nystagmus intensifies if the pt attempts to abduct either eye.
Comitant Esotropia

Ciancia syndrome
Comitant Esotropia

Congenital (onset < age 6 m)  Acquired (onset > age 6 m)

With nystagmus  W/o nystagmus

- Nystagmus blockage syndrome
- Latent nystagmus
- Ciancia syndrome

Acquired ET is also divvied two groups:
Those that are *accommodative* in nature,
and those that are *nonaccommodative*
Comitant Esotropia

Congenital (onset < age 6 m)  
- With nystagmus  
- W/o nystagmus  

Acquired (onset > age 6 m)  
- Accommodative  
- Nonaccommodative

**Accommodative esotropia** refers to ET stemming from activation of the accommodative (aka near) reflex. Recall that the accommodative reflex has three components: *accommodation, miosis*, and *convergence*. Recall further that *accommodation* refers to the cranking in of lenticular ‘plus’ power to overcome hyperopic blur.
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Accommodative ET typically arises around age 2-3 years. It is intermittent initially, eventually progressing to become constant. The child will often complain of diplopia at first, but stops after developing a facultative suppression scotoma. (A facultative suppression scotoma is one that is active only while the eye is deviated.) Amblyopia is common.
Comitant Esotropia

Congenital (onset < age 6 m)
  - With nystagmus
    - Nystagmus blockage syndrome
    - Latent nystagmus
    - Ciancia syndrome
  - W/o nystagmus

Acquired (onset > age 6 m)
  - Accommodative
    - Refractive
    - Nonrefractive
  - Nonaccommodative

Accommodative ET is further divvied into two forms: Refractive, and Nonrefractive
**Refractive accommodative esotropia** is pretty straightforward: It is due primarily to being a high hyperope (average ~4D). For these kids, the severe accommodative exertion required to overcome their hyperopia stimulates so much convergence (via the near reflex) that their divergence inputs get swamped, and their eyes turn in.
Refractive accommodative esotropia is pretty straightforward: It is due primarily to being a high hyperope (average ~4D). For these kids, the severe accommodative exertion required to overcome their hyperopia stimulates so much convergence (via the near reflex) that their divergence inputs get swamped, and their eyes turn in. Key exam finding: The amount of esotropia measured with the child looking at near, ET’ (note that the singlequote mark after the T indicates we’re talking about alignment during near gaze) is roughly equal to the amount measured when the child is looking at distance, ET (note the absence of the singlequote, meaning this refers to alignment at distance).
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Refractive accommodative ET is managed by prescribing the full cycloplegic refraction, which should eliminate the accommodation→convergence→ET chain at the source. If residual ET’ is present, a bifocal should be employed.
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Refractive accommodative ET is managed by prescribing the full cycloplegic refraction, which should eliminate the accommodation→convergence→ET chain at the source. If residual ET’ is present, a bifocal should be employed. *Over time, the plus power should be weaned off as tolerated (by the child’s eyes remaining straight).*
The mechanism underlying *nonrefractive accommodative esotropia* is less straightforward. As in its refractive cousin, nonrefractive accommodative esotropia is secondary to convergence induced by accommodation for which divergence inputs are insufficient to keep the eyes straight.
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We have noted several times now that the near reflex yokes convergence to accommodation. As would be expected, the amount of convergence stimulated by the near reflex is proportional to the amount of accommodation needed to see something—simply put, closer objects require more accommodation to be seen clearly, and because they're closer, they require more convergence to be bifixated.
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How best to manage high AC/A ratio accommodative esotropia is unsettled as of this writing. Some specialists elect observation so long as the child’s eyes are pretty straight at distance. Others argue that bifocals are worth a try, provided you ensure the kid actually uses the add appropriately. Surgical correction can be countenanced, but is labeled “controversial” by the Peds book. While the ideal outcome would obviously be resolution of the ET at both distance and near, most specialists could live with a small amount (<10Δ) of ET at near.
Comitant Esotropia

Congenital (onset < age 6 m)

With nystagmus
- Nystagmus blockage syndrome
- Latent nystagmus
- Ciancia syndrome

W/o nystagmus

Acquired (onset > age 6 m)

Accommodative

Refractive

Nonrefractive

Nonaccommodative

The mechanism underlying nonrefractive accommodative esotropia is less straightforward. As in its refractive cousin, nonrefractive accommodative esotropia is secondary to convergence induced by accommodation for which divergence inputs are insufficient to keep the eyes straight. However, the underlying issue is not one of high hyperopia per se, but rather of a clinical issue called a high AC/A ratio. Let’s unpack this important concept.

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Congenital (onset < age 6 m)

- With nystagmus
  - Nystagmus blockage syndrome
  - Latent nystagmus
  - Ciancia syndrome
- W/o nystagmus

Acquired (onset > age 6 m)

- Accommodative
  - Refractive
  - Nonrefractive
- Nonaccommodative
  - Basic
  - Sensory
  - Divergence insufficiency
  - Spasm of the near
  - Consecutive
  - Cyclic

The *Peds* book discusses several forms of acquired nonaccommodative esotropia.
Basic nonaccommodative esotropia is, in essence, the acquired version of congenital esotropia w/o nystagmus: The child is not a high hyperope, and the size of the deviation is similar distance and near.
Basic nonaccommodative esotropia is, in essence, the acquired version of congenital esotropia w/o nystagmus: The child is not a high hyperope, and the size of the deviation is similar distance and near. Management consists of patching (if needed, to sweeten up VA if amblyopia has set in), followed by surgical intervention for the full prism-adapted deviation.
**Comitant Esotropia**

- **Congenital** (onset < age 6 m)
  - With nystagmus
  - W/o nystagmus
    - Nystagmus blockage syndrome
    - Latent nystagmus

- **Acquired** (onset > age 6 m)
  - Accommodative
    - Basic nonaccommodative esotropia is, in essence, the acquired version of congenital esotropia w/o nystagmus: The child is not a high hyperope, and the size of the deviation is similar distance and near. Management consists of patching (if needed, to sweeten up VA if amblyopia has set in), followed by surgical intervention for the full prism-adapted deviation.
  - Nonaccommodative

  **Prism adaptation** is a process in which the pt is prescribed the full prism needed to nullify their ET, then re-evaluated periodically to determine whether additional ET has been 'uncovered.' If it has, the prescription is updated to nullify the additional ET.
Comitant Esotropia

Congenital (onset < age 6 m)
- With nystagmus
  - Nystagmus blockage syndrome
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Acquired (onset > age 6 m)
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  - Basic
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Prism adaptation is a process in which the pt is prescribed the full prism needed to nullify their ET, then re-evaluated periodically to determine whether additional ET has been ‘uncovered.’ If it has, the prescription is updated to nullify the additional ET. This is repeated until the prism prescription is stable, at which time surgery is performed to correct the full final prism prescription.
**Comitant Esotropia**

- **Congenital (onset < age 6 m)**
  - With nystagmus
    - Nystagmus blockage syndrome
    - Latent nystagmus
    - Ciancia syndrome
  - W/o nystagmus

- **Acquired (onset > age 6 m)**
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  - Nonaccommodative
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If there is anything hinky about the presentation (eg, any neuro signs/symptoms; face turn; c/o HA), imaging should be obtained.
Congenital (onset < age 6 m)  

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  - Nystagmus blockage syndrome
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Acquired (onset > age 6 m)  

- Accommodative
  - Refractive
  - Nonrefractive
- Nonaccommodative
  - Basic
  - Sensory
    - Divergence insufficiency
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**Sensory** (aka *deprivational*) **nonaccommodative esotropia** develops in response to monocular vision loss. Common causes include cataracts, corneal clouding, and retinal or optic nerve disorders. The lack of symmetric visual stimulation leads to amblyopia, followed by a breakdown in fusion.
Earlier in this slide-set we mentioned supranuclear divergence inputs that prevent overconvergence. In **divergence insufficiency**, a lack of robustness on the part of these inputs allows the eyes to turn in a bit, resulting in a modest esotropia.
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Note that these conditions can be differentiated on the basis of the relative magnitude of the esotropia as a function of whether it is measured at distance vs near:

- **Accommodative refractive esotropia**: $ET \approx ET'$
- **Accommodative nonrefractive (high AC/A ratio) esotropia**: $ET < ET'$
- **Divergence insufficiency**: $ET > ET'$
Earlier in this slide-set we mentioned supranuclear divergence inputs that prevent overconvergence. In divergence insufficiency, a lack of robustness on the part of these inputs allows the eyes to turn in a bit, resulting in a modest esotropia. The classic presentation is that of an esotropia that is present at distance, but not at near. The most common form of this develops in older individuals—hence its alternative name, age-related distance esotropia. In some pts, imaging reveals age-related structural changes to the EOMs or orbital ligamentous support structures. Prisms, Botox injection, and surgery have all proven safe and effective interventions.
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- Nonaccommodative
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  - Sensory
  - Divergence insufficiency
  - Spasm of the near
  - Consecutive

**Spasm of the near** (aka convergence spasm) is almost always a functional response to psychosocial stressors. All three components of the near triad (convergence, miosis and accommodation) can usually be demonstrated. The esotropia may alternate with periods of orthotropia. Abduction will be poor or absent when the eyes are tested simultaneously, but full when tested monocularly.
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Consecutive esotropia refers to esotropia that develops in someone with a history of exotropia. In almost all cases, consecutive esotropia is post-surgical, ie, it represents an apparent overcorrection in someone who underwent strab surgery for exotropia.
**Comitant Esotropia**

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  - **Consecutive**
  - Cyclic

**Consecutive esotropia** refers to esotropia that develops in someone with a history of exotropia. In almost all cases, consecutive esotropia is post-surgical, ie, it represents an apparent overcorrection in someone who underwent strab surgery for exotropia. That said, consecutive esotropia often resolves spontaneously, so unless it is very large (in which case it likely represents a slipped/lost muscle), observation is usually the preferred management option.
Cyclic esotropia is a rare disorder in which a comitant ET is present intermittently, usually every other day. The typical pt is pre-school age. Surgical correction of the maximum observed ET is the treatment of choice.