Torsional Diplopia\textsuperscript{1,2}

- Binocular diplopia
  - Typically associated with vertical diplopia most commonly with 4\textsuperscript{th} Cranial Nerve Palsy
  - Diplocic image is often twisted or blurred
  - Often worse in down gaze
- History of head trauma
- Diplopia response on prism offset
  - “Fuzzy”
  - “Twisted”
  - “Diagnol”
- Amblyoscope Exam
  - Measure the amount of torsion present
  - Can offset torsion to test for fusional response

\textsuperscript{1} Woo SJ, Seo JM, Hwang JM; Clinical characteristics of cyclodeviation. Eye (Lond) 2005; 19 (8) :873-8.
“Retinal” Diplopia$^{3,4}$

- Vertical diplopia, eliminated with occlusion of either eye
- Worse at distance
- Worse under photopic conditions
- Monocular visual disturbances, not relieved with pinhole
  - Metamorphopsia
  - Blur
  - Distortion
  - Illusory movement of fixation target
- Horizontal phoria or mismatch between subjective complaints and objective findings
- Fair to good stereopsis
- Poor sensory fusion
  - Diplopia relieved only temporarily with prism
  - “Eats up” vertical prism over time
- + Lights-on, lights-off test

---


Paradoxical Diplopia Secondary to Anomalous Binocular Correspondence\textsuperscript{5,6}

- Binocular diplopia
  - Typically horizontal (crossed or un-crossed)
  - Diplopic image is often in the direction opposite than that expected (given alignment)
  - Often intermittent
  - Often worse in dim illumination
- History of constant, childhood-onset strabismus
- Diplopia response on fovea-to-fovea sensory tests
  - Diplopia with prism offset of deviation on red filter, Bagolini, or Worth 4-dot tests
  - Diplopia response on after-image test
- Amblyoscope Exam
  - Sensory angle ≠ Motor angle
  - Presence of "pseudo-fovea"
  - Presence of suppression scotoma that may be in unexpected location (given alignment)


Central Disruption of Fusion/ Horror Fusionis7,8

- Central Disruption of Fusion
  - CNS basis for loss of pre-existing fusion ability
  - Can involve loss of sensory fusion, loss of motor fusion or loss of both sensory and motor fusion
- Horror Fusionois
  - Absence of central fusion combined with absence of central suppression usually associated with childhood strabismus or longstanding unilateral loss of vision
- Important to diagnose / rule out pre-operatively when considering EOM surgery to treat diplopia
- Who is at risk
  - Visually mature patients (adults/teenagers) with:
    - Longstanding constant deviation (HF)
    - Sensory deviation secondary to longstanding unilateral loss of vision, now with VA recovered (HF)
    - Constant diplopia with history of head injury associated with loss of consciousness (CDF)
    - Constant diplopia and acquired CNS lesion/mass (usually midbrain, rare) (CDF)
- Evaluation
  - Prism neutralization with red filter
  - Amblyoscope
    - More sensitive
    - Can neutralize cyclo deviations

---

Monocular Diplopia\textsuperscript{9,10}

- Can be physiologic or pathologic
  - External irregularities of the eyelids or cornea
  - Uncorrected irregular corneal astigmatism (most common)
  - Early keratoconus
  - Lenticular changes
  - Macular cystoid changes
  - Large neurologic scotomas with bisect fixation
  - Intracerebral hemorrhage or tumors in or near area 19

- Acquired, never congenital

- Complaints of second "shadow" image
  - Primary image is always darker and better defined than the secondary image
  - Typically images are vertically displaced, but can be horizontal
  - Usually worse or more noticeable in the distance

- Diplopia still present after one eye has been occluded
- Diplopia relieved with pinhole test
- Small to no phoria present on cover test
- Fair stereopsis
- Mildly decreased vision in the eye with the symptoms
- Retinoscopy is best diagnostic tool

American Orthoptic Council Workshop:
When the Patient Sees Double and the Doctor Sees Nothing
A Guide to Double Vision

AAPOS 37th Annual Meeting – San Diego, CA
April 1, 2011

Melinda Rainey, MD; Kyle Arnoldi, CO; Jorie Jackson, CO; Rich Freeman, MD; Aaron Miller, MD; Cindy Pritchard, CO

I. Who is at risk for double vision?
   a. Patients with refractive error
      i. Uncorrected refractive error
      ii. Aniseikonia
   b. Patients with strabismus
      i. Acquired strabismus
         1. Secondary to trauma
         2. Secondary to systemic disease
         3. Decompensation of phoria
      ii. Loss of or change in suppression
         1. Fixation Switch Diplopia due to change in refractive error or visual acuity
         2. Aggressive anti-suppression exercises
         3. Loss of suppression due to emotional or physical trauma
      iii. Sensory strabismus
         1. Poor visual acuity in one eye
         2. Significant visual field loss in one or both eyes
   c. Patients with macular or paramacular pathology
      i. Retinal “wrinkle” or pucker
      ii. Retinal membrane
      iii. Traction
   d. Patients with significant visual field loss in one or both eyes
      i. Advanced glaucoma
      ii. Sensory visual pathway disease
   e. Patients with an abnormal fusion mechanism
      i. Disrupted sensory fusion mechanism in the primary or secondary visual cortex
         1. Central loss of fusion due to brain injury or prolonged monocular deprivation
         2. Maldevelopment of sensory fusion mechanism due to infantile strabismus or visual deprivation (i.e.: congenital cataract)
      ii. Disrupted motor fusion mechanism (vergence system) in the tertiary cortex, motor cortex, or brainstem
         1. Acquired (i.e.: Parkinson’s Disease)
         2. Congenital (i.e.: Cerebral Palsy)

II. The Exam
   a. History
      i. Does the double vision disappear when you cover one eye?

1 These patients typically have strabismus, though it is often intermittent.
1. Yes: binocular diplopia
2. No: monocular diplopia

ii. What event coincided the onset of your double vision?
   1. Trauma to head or face
      a. Was there a loss of consciousness?
   2. Illness
      a. Recent diagnosis of systemic disease?
         i. Diabetes
         ii. Multiple Sclerosis
         iii. Thyroid dysfunction
         iv. Neoplasm
      b. Acute illness (“flu”)
   3. Change in glasses and/or optical correction
      a. Change in prescription strength
      b. New bifocals or new type of bifocal
      c. Glasses to contact lenses (or contacts to glasses)
      d. Refractive surgery
   4. Change in visual activities
      a. Increase in frequency of night driving
      b. Increase in amount of near work
   5. Other symptoms
      a. Headache
      b. Vertigo
      c. Visual confusion (two different images superimposed in the same location)
      d. Loss of depth perception
   iii. Is the double vision constantly present, intermittent, or variable?
      1. Is the double image always there, but image changes location in space?
      2. Does the double image appear and disappear, but remain in the same location relative to fixation?
   iv. Do you have a history of strabismus, “lazy eye”, or glasses wear as a child?²
   v. Is there a position or visual circumstance in which you do NOT see double?
      1. Patient may not be aware of his/her head posture
      2. Check old photos (i.e.: driver’s license) for evidence of pre-existing head posture

b. Visual Acuity
   i. Which is the dominant eye?
   ii. Does the dominant eye have the better acuity?

c. Refractive Error
   i. Refractometry

² If the patient has no history of diplopia, he/she may not associate the childhood strabismus with a new onset double vision and fail to mention it.
1. Patients with history of amblyopia or childhood-onset strabismus may need objective refractometry (retinoscopy) and/or cycloplegic refractometry

d. Motility
   i. Is there a field or gaze of single vision?
      1. Is the patient truly binocular in this field?
   ii. Determine if manifest strabismus is present in critical gaze positions using cover-uncover test
      1. Driving position (primary position at distance)
      2. Reading position (down gaze at near)
      3. Computer position (primary position at arm’s length)
      4. Any other gaze position that is occupationally relevant to patient

e. Binocularity
   i. Define characteristics of diplopia
      1. Test technique
         a. Place red filter over better-seeing eye
         b. Direct gaze to light source or lighted acuity chart (single letter)
         c. Dim room lights
      2. Where is the red image, relative to the white? (If diplopia is binocular, second image should always be in the field opposite to that where the eye is pointing.)
         a. If eye is in towards the nose (esotropia), then image from that eye is temporally displaced.
         b. If eye is out towards ear (exotropia), then image from that eye is nasally displaced.
         c. If eye is up (hypertropia), then image is down.
         d. If eye is down (hypotropia), then image is up.
         e. Presence of pre-existing anomalous fusion mechanism is indicated if:
            i. Patient is diplopic, but unable to localize second image in space
            ii. Location of double image “doesn’t make sense” given type of deviation
   ii. Assess fusion potential
      1. Add increasing prism with apex toward the direction of the misalignment until images fused (good fusion potential)
         a. Esotropia: base-in
         b. Exotropia: base-out
         c. Hypertropia: base-down
         d. Hypotropia: base-up
      2. If patient unable to fuse with any combination of prisms and red filter (poor fusion potential)
         a. Turn on room lights, remove red filter, keep prisms in place. Does the patient now see single?
b. Rule out cyclotropia with double Maddox rod test or amblyoscope

c. Rule out anomalous fusion mechanism
   i. Amblyoscope Exam
   ii. Bagolini Lenses
   iii. After Image

III. The Clinical Characteristics of Diplopia

a. Retinal Diplopia
   i. Vertical diplopia eliminated with occlusion of either eye
   ii. Worse at distance
   iii. Worse under photopic conditions
   iv. Monocular visual disturbances, not relieved with pinhole
      1. Metamorphopsia
      2. Blur
      3. Distortion
      4. Illusory movement of fixation target
   v. Horizontal phoria or mismatch between subjective complaints and objective findings
   vi. Fair to good stereopsis
   vii. Poor sensory fusion
      1. Diplopia relieved only temporarily with prism
      2. “Eats up” vertical prism over time
   viii. +Lights-on, lights-off test

b. Central Loss of Fusion
   i. CNS basis for loss of pre-existing fusion ability
   ii. Can involve loss of sensory fusion, loss of motor fusion, or loss of both sensory and motor fusion
   iii. Those at risk include Visually mature patients with:
      1. Constant diplopia with history of head injury associated with loss of consciousness
      2. Constant diplopia and acquired CNS lesion/mass (usually midbrain, rare)
   iv. Amblyoscope is best diagnostic tool

c. Horror Fusionis
   i. Absence if central fusion combined with absence of central suppression usually associated with childhood strabismus or longstanding unilateral loss of vision
   ii. Those at risk include visually mature patients with:
      1. Constant deviation with/without diplopia with unclear history
      2. Longstanding constant deviation
      3. Sensory deviation secondary to longstanding unilateral loss of vision, now with recovered vision
   iii. Amblyoscope is best diagnostic tool

d. Torsion

---

3 This requires special sensory testing and equipment. Patient should be referred to an orthoptist.
i. May or may not have associated vertical misalignment
ii. Sometimes worse when reading
   1. Can be worse in down gaze
iii. Complains images are blurred or “shadowed”
   1. Relieved with either eye occluded

e. Monocular
i. Causes may be physiologic or pathologic and include
   1. External irregularities of the eyelids or cornea
   2. Uncorrected irregular corneal astigmatism
   3. Early keratoconus
   4. Lenticular changes
   5. Macular Cystoid changes
   6. Large neurologic scotomas with bisect fixation
   7. Intracerebral hemorrhage or tumors in or near area nine-teen
ii. Complains of second “shadow” image
   1. Primary image is always darker and better defined than the secondary image
   2. Typically images are vertically displaced, but can be horizontal
   3. Usually worse or more noticeable in the distance
iii. Acquired, never congenital
iv. Diplopia still present with either eye occluded
v. Diplopia often relieved with pinhole test
vi. Small to NO phoria present on cover test
vii. Fair stereopsis
viii. Mildly decreased vision in eye with symptoms
ix. Retinoscopy is best diagnostic tool

f. Paradoxical
i. Secondary to anomalous binocular correspondence
ii. Binocular diplopia
   1. Typically horizontal (crossed or un-crossed)
   2. Diplopic image is often in the direction opposite than the expected (given alignment)
   3. Often intermittent
   4. Often worse in dim illumination
iii. History of constant, childhood-onset strabismus
iv. Diplopia response on fovea-to-fovea sensory tests
   1. Diplopia with prism offset of deviation on red filter, Bagolini, or Worth-4-dot tests
   2. Diplopia response on after-image test
v. Amblyoscope Exam
   1. Sensory angle Motor angle
   2. Presence of “pseudo-fovea”
   3. Presence of suppression scotoma that may be in unexpected location (given alignment)
IV. The Management
   a. Optical
      i. Best for patients with
         1. Refractive error, already wearing optical correction
         2. Straight eyes
         3. Monocular or binocular diplopia
         4. Strongly dominant eye
      ii. Options
         1. Refractive blur of non-dominant eye
            a. “over-plus” non-dominant eye
         2. Alter plane of refractive correction
            a. Glasses to contact lenses or reverse
         3. Change bifocal type
            a. Progressive to D-seg, or reverse
         4. Contact Lens
            a. Better for irregular corneal astigmatism
   b. Orthoptic
      i. Best for patients with
         1. Intermittent strabismus
         2. Good fusion potential
         3. Good health and highly motivated
      ii. Options
         1. Teach suppression\(^4\)
         2. Improve fusional vergence amplitudes
   c. Occlusion
      i. Best for patients with
         1. Double vision and straight eyes
         2. Poor fusion potential
         3. Strabismus, but poor candidate for other therapies
      ii. Options
         1. For those who don’t already wear glasses
            a. “Pirate patch”
            b. Occlusive contact lens
            c. Adhesive patch
         2. For those who wear glasses
            a. Frosted adhesive tape
            b. Clear nail polish
            c. Bangerter filter
            d. Min lens
   d. Prism
      i. Best for patients with

\(^4\) Teaching fusion typically results in permanent diplopia and is NOT recommended.
1. Diplopia due to small angle strabismus (< 12∆)
2. Good fusion potential
3. Comitant deviation that is similar at distance and near fixation
4. Refractive error, already wearing glasses

ii. Options
   1. Fresnel temporary press-on prisms
   2. Ground-in to spectacles
   3. Displaced optical centers (only possible if refractive error is high)

e. Surgery
   i. Best for patients with
      1. Diplopia due to large angle strabismus or torsion
      2. Incomitant deviation
      3. Good fusion potential
   ii. Options: depend on type of strabismus
Further Reading


