Evaluation of Pediatric Nystagmus

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Gena Heidary, M.D., Ph.D.
Director, Pediatric Neuro-ophthalmology Service
Boston Children's Hospital
Harvard Medical School

Disclosures

- I have no relevant financial or commercial disclosures.

Nystagmus

- Involuntary to and fro oscillation of the eyes with an initial slow movement followed by a refixation movement

- Pathologic as it interferes with visual function and may be associated with a compensatory head posture

- Distinct from saccadic intrusions and other oscillatory eye movements

Clinically Useful Terms to Describe Nystagmus

- Monocular or binocular
- If binocular, conjugate?
- Plane: horizontal, vertical, torsional
- Velocity
  - Slow-slow: pendular nystagmus
  - Slow-fast: jerk nystagmus
- Amplitude
  - Excursion of eyes in each direction
- Frequency
  - Cycles of back and forth movement/second

Role of the pediatric ophthalmologist

- Clarify the type of eye movement
- Initiate the appropriate treatment based on that evaluation
- Manage the nystagmus
  - Maximize visual function
  - Address associated strabismus
  - Address anomalous head posture when relevant
  - Low vision evaluation for appropriate accommodations

Classification Scheme for Nystagmus

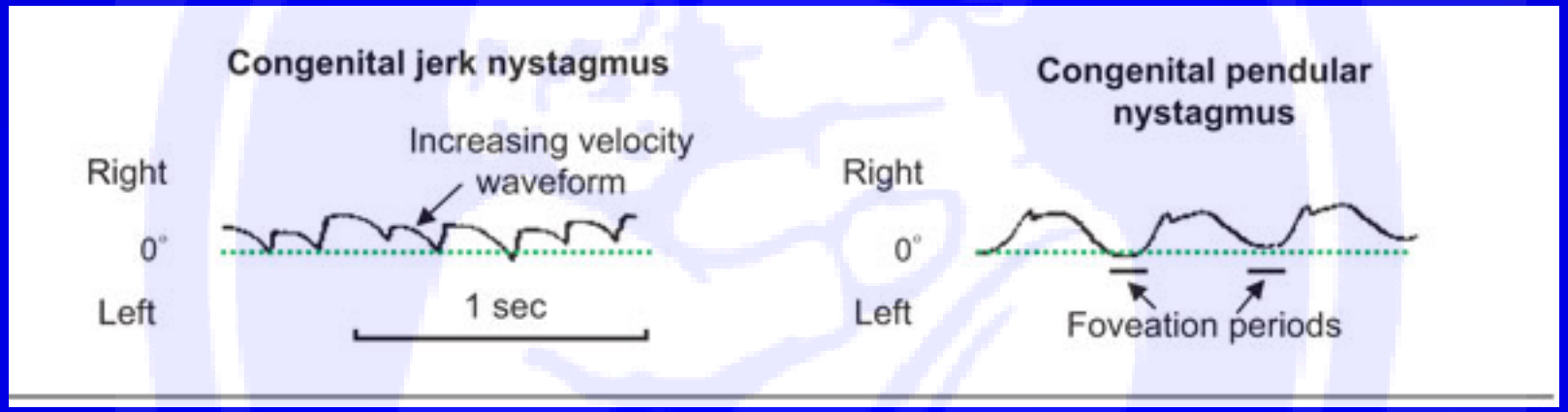
- Infantile forms
  - Infantile Nystagmus Syndrome
  - Fusion maldevelopment syndrome (latent nystagmus)
  - Spasmus Nutans
  - Down syndrome (17% among 806 patients at BCH; JPOS 2016).
- Acquired forms
  - Associated with neurologic disease (ex. Pelizaeus-Merzbacher)
  - Other forms associated with peripheral vestibular dysfunction

Infantile nystagmus syndrome

- Encompasses “congenital nystagmus” both “sensory” and “motor”
- Identified during infancy, onset before 6 months of life
- Onset most commonly at 8 to 12 weeks of age

Clinical Features of Infantile Nystagmus Syndrome

- Conjugate, pendular or jerk nystagmus



Wong, Eye Movement Disorders, p.105.

- Usually horizontal
- Horizontal in vertical gaze
- Right beating in right gaze, left beating in left gaze

Infantile Nystagmus Syndrome Characteristics

- Punctuated by foveation period
- Dampens with convergence
- Exacerbated by fixation
- Rare to report oscillopsia
- Null zone with associated head turn
- With-the rule-astigmatism
- Reversal of optokinetic response

Video

Etiology of Infantile Nystagmus Syndrome

- Sensory/Afferent visual pathway disease
- Idiopathic

Afferent visual pathway disease

- Structural abnormalities
  - Corneal opacity
  - Colobomata
  - Aniridia
  - Congenital cataracts
- Congenital retinal dystrophies/retinal degeneration
  - Achromatopsia
  - Blue cone monochromatism
  - Leber Congenital Amaurosis
  - Cone-rod dystrophy
  - Congenital Stationary Night Blindness
- Ocular albinism
- Optic nerve hypoplasia

Signs of Nystagmus secondary to Retinal Disease

- High myopia
- High hyperopia
- Severe photophobia
- Paradoxical pupillary response
- Oculodigital stimulation

Evaluation of sensory system

- Refraction
- Electrophysiology when indicated
  - Signs of retinal dystrophy
- When to image?
  - Optic nerve hypoplasia
  - Multiplanar nystagmus, vertical, torsional nystagmus

Idiopathic Infantile Nystagmus Syndrome

- Prevalence approximately 2 in 1000
- Pathophysiology poorly understood
- Inheritance
  - -X-linked associated with *FRMD7* mutations
  - -Autosomal dominant, implicated loci include 6p12, 7p11, 15q11 Kerrison, Am. J. Ophthal., 1998; Klein et al, Genomics, 1998; Patton, J. Med. Genet., 1993.

Idiopathic Infantile Nystagmus Syndrome

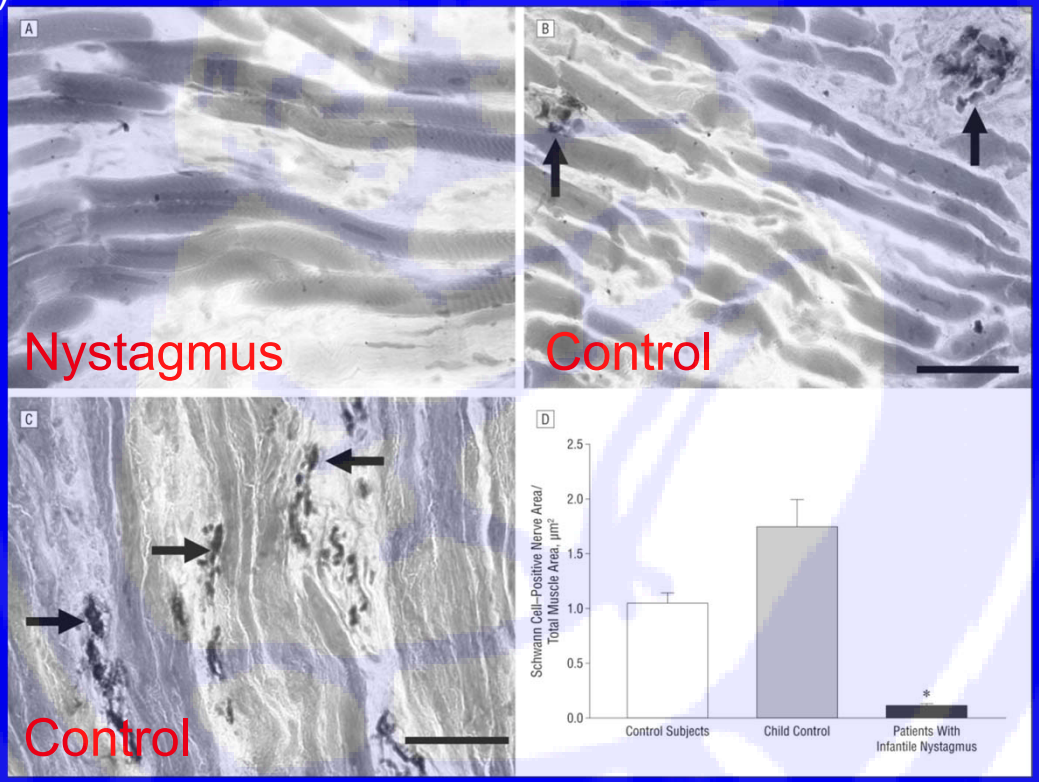
- FERM domain-containing protein 7 (FRMD7) expressed in retina, midbrain and hindbrain

- Homologous amino acid sequence to FARP1 and FARP2 which play a role in neurite outgrowth and branching

- Anomalous innervation of extraocular muscles or pathways that promote gaze stability?

Aberrant innervation hypothesis

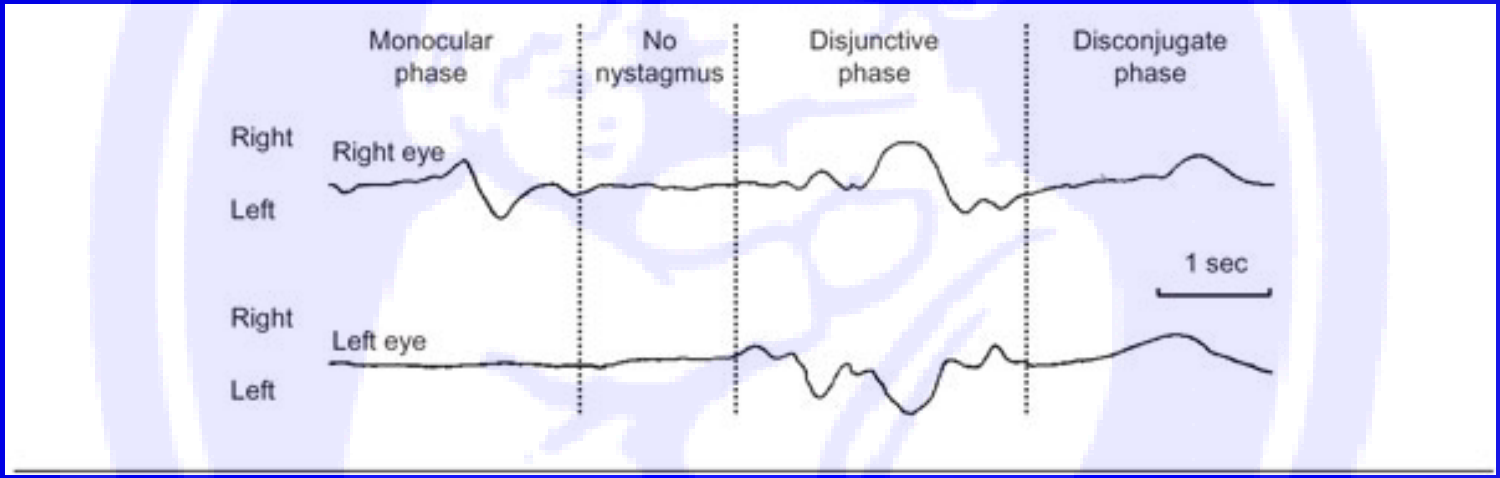
- Supported by histopathologic analysis of EOMs from patients with nystagmus (Berg KT, Hunter DG, et. al, Arch. Ophthalmol., 2012)



Sparsely innervated EOMs in nystagmus.

Spasmus nutans

- Triad of nystagmus, head nodding, and abnormal head position



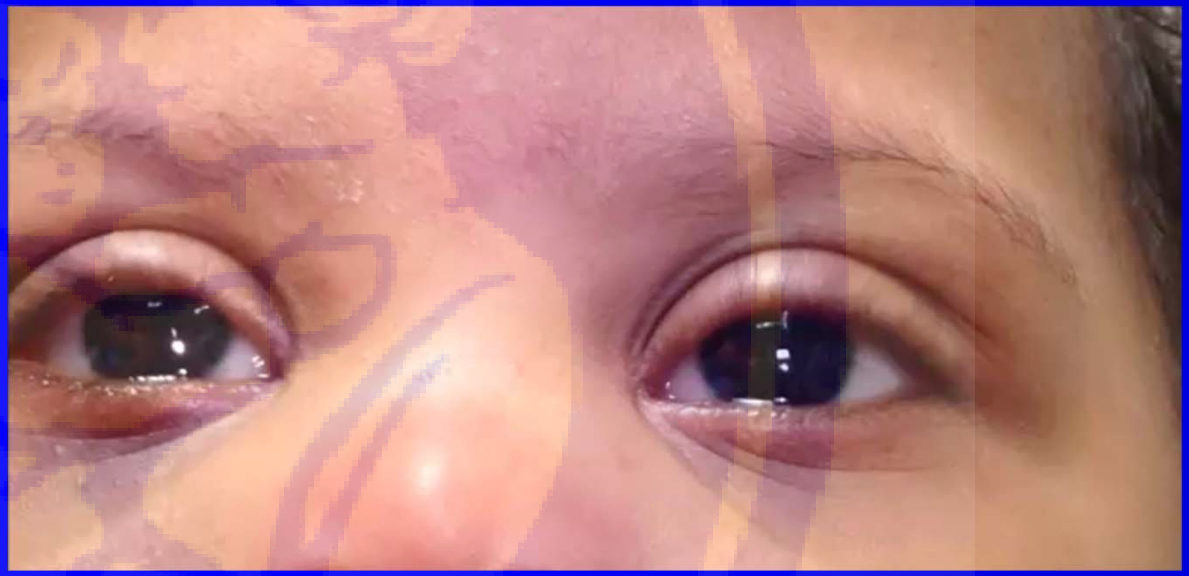
Wong, Eye Movement Disorders, p.107.

- Onset most commonly at 6 to 12 months
- Spontaneous resolution at 1 to 2 years following its onset

Spasmus nutans

- Head nodding
  1. Horizontal component (shaking)
  2. Vertical component (bobbing)
  3. May by compensatory by attenuating the intensity of the nystagmus
- Head position
  1. Present in approximately 2/3 patients

Video



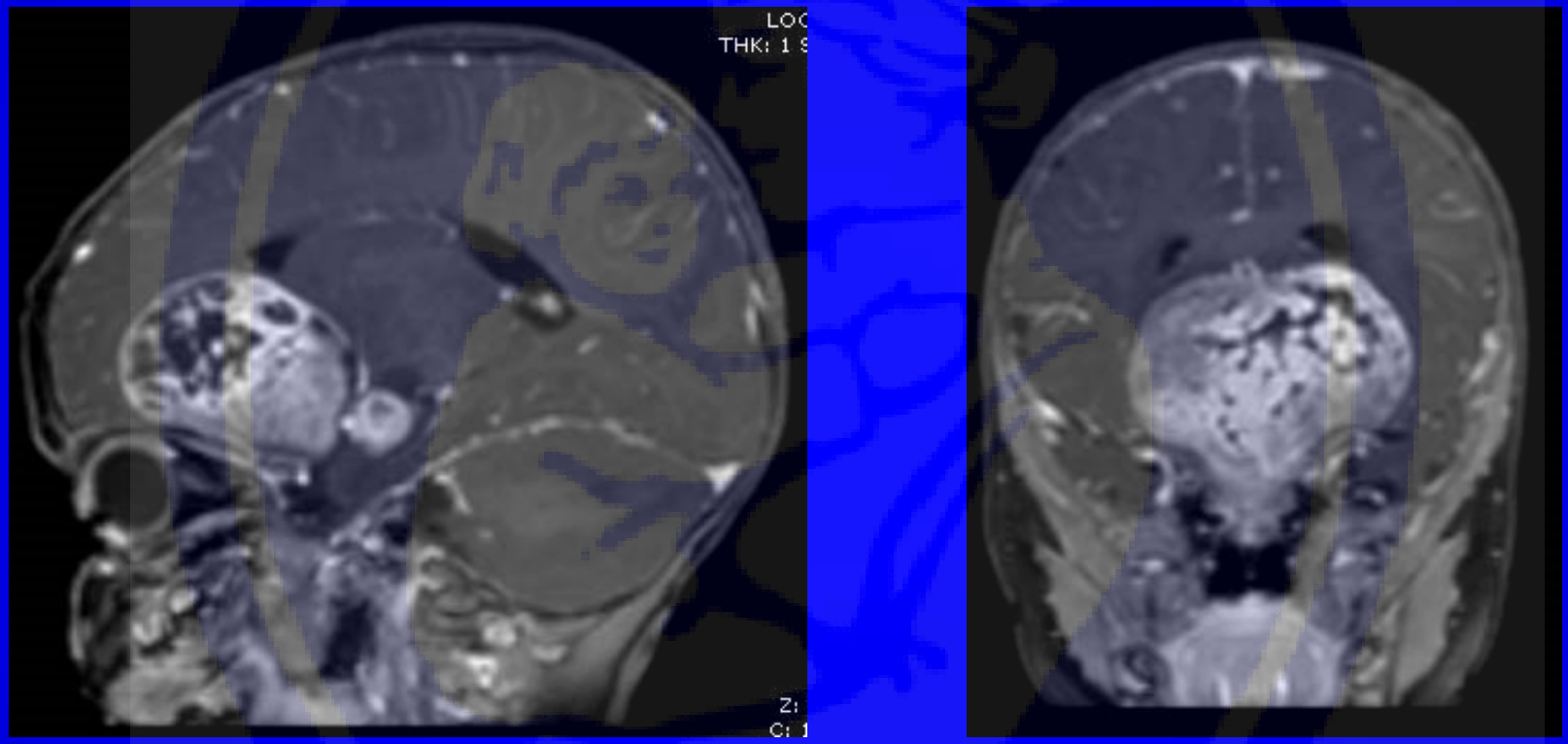
Spasmus nutans

- Distinct from infantile nystagmus as the eye movements are dysconjugate and of higher frequency

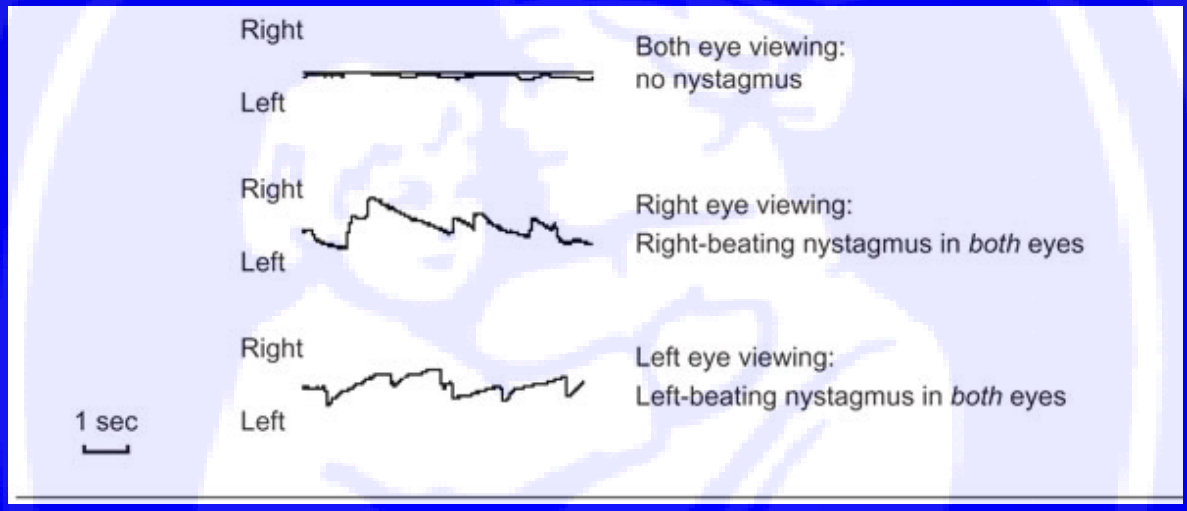
- Evaluation should always include MRI brain to exclude tumor of the anterior visual pathway

Video

MRI Findings



Fusional maldevelopment nystagmus (Latent/Manifest latent nystagmus)



Wong, Eye Movement Disorders, p.106.

- Conjugate horizontal jerk nystagmus with fast phase beating towards the uncovered eye
- Associated with esotropia

Acquired nystagmus

Video

See-Saw nystagmus

See-saw nystagmus

- Most common etiologies:
  1. Parasellar tumor (craniopharyngioma, pituitary adenoma)
  2. Joubert syndrome

Video

Upbeat nystagmus

Upbeat nystagmus

- Most common etiologies:
    1. Wernicke encephalopathy
    2. Stroke
    3. Demyelinating processes, i.e. multiple sclerosis
    4. Tumors of medulla, cerebellum or midbrain
- Characteristics:
    1. Exaggerated in upgaze but not lateral gaze
    2. Distinct from gaze evoked nystagmus in upward gaze

Downbeat nystagmus

- Most common etiologies:
    1. Lesions at cervicomedullary junction: Chiari malformation
    2. Cerebellar degeneration
    3. Drug intoxication: lithium
    4. Demyelinating processes, i.e. multiple sclerosis
- Characteristics:
    1. Exaggerated in down and lateral gaze

Video

Voluntary nystagmus

Voluntary nystagmus

- May be initiated by facial movement or grimace
- Unsustained in duration

Video

Opsoclonus

- Conjugate, multi-directional saccadic oscillations
  - "Saccadomania" or "dancing eyes"
- "…continuous vertical and horizontal movements…categorically distinct from nystagmus in lacking the rhythmicity or regularity which by definition is the sine qua non of nystagmus." David Cogan, Arch Ophthalmol. 1968; Arch Ophthalmol. 1954.
- Eye movements are involuntary
- Present irrespective of fixation, convergence, or sleep

Pediatric Opsoclonus-Myoclonus Syndrome

- Typical age of onset before 3 years (median 18-22 months)
- Clinical features:
  - Ataxia/ myoclonus
  - Opsoclonus
  - Sleep dysfunction or irritability

Matthay et al., Cancer Letters. 2005.

- Etiology
  - Paraneoplastic: neuroblastoma in ~ 50% of cases
  - Encephalitis: mumps, rubella, coxsackie B virus

- Monophasic or chronic, relapsing
- Associated with speech, motor, neurocognitive disability

Management

- Work up
  - MRI brain to exclude alternative etiology
  - Chest X-ray and abdominal ultrasound
  - Urine HVA and VMA (low sensitivity)
  - MRI torso from neck to abdomen if above studies are normal
  - Lumbar puncture
- Treatment
  - Tumor resection when relevant
  - Immunosuppression
    Corticosteroids, IVIG, rituximab, plasma exchange
- Early diagnosis may be associated with more favorable long term outcome

Nystagmus evaluation

- Characterization of the eye movement through careful and patient observation

- Systematic approach including detailed history documenting onset of symptoms, medical history, medication history

- Examination including CRNS and determination of any structural abnormalities

- Adjunctive testing
  - -ERG when indicated
  - -Neuroimaging when indicated