

Cortical/Cerebral Visual Impairment

Is it one or several or entities?

Can it co-exist with ocular impairments?

SESSION TWO

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In this webinar...

- Briefly review classification of pediatric brain related vision loss
- 4 Case Examples
 - Cortical VI
 - Cerebral VI – Ventral
 - Cerebral VI – Dorsal + Ocular + Ocular Motor
 - Cerebral VI – Dorsal - Ventral

Classification of Vision Loss

- **Ocular**
 - Eye structures, to chiasm
- **Ocular motor**
 - Brain stem, basal ganglia, thalamus, cerebellum
- **Cortical**
 - Primary pathway (post-chiasm to occipital)
- **Cerebral**
 - Post-occipital, complex brain processing areas

Pediatric Brain Damage and Vision Impairment

Causes of pediatric brain damage

- Encephalopathy
- Maldevelopment
- Trauma – accidental and non-accidental
- Seizures
- Neurodegenerative disorders

CLASSIFICATION OF VISUAL IMPAIRMENT BY CAUSE

Ocular Motor

Brain stem,
cerebellum

Ocular

Ocular media, retina,
optic nerve, to chiasm

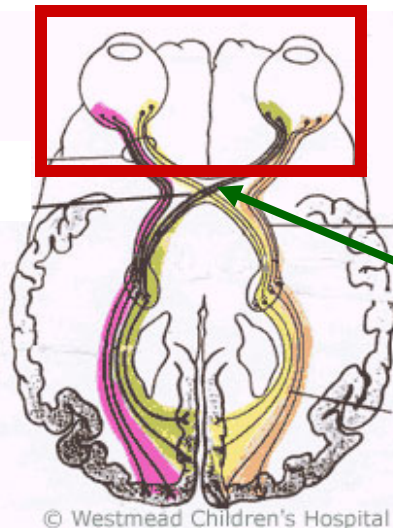
Cortical

post-chiasm to V1
(striate or occipital)

Cerebral

post-V1
(parietal, temporal lobes,
motor cortices & frontal lobes)

Ocular Vision Impairment



Chiasm

Pre-chiasmal visual pathway

Eyes, retina, optic nerves

- Significant uncorrected refractive error
- Media opacities (ie. cataracts)
 - Retinal lesions
 - Retinal degeneration/dystrophy
 - Optic nerve damage

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Patient A. **Cortical VI**

Age: 5.5 yrs

Medical Hx

- Neonatal sepsis
- Infantile spasms
- Severe cerebral atrophy
- Global delays



Patient A. **Cortical VI**

Visual Function

- **Visual acuity** (glasses, both eyes viewing)
 - **“20/360” for TAC gratings**
 - Individualized presentation
- **Visual field**
 - **Severely impaired**
 - **Suspect small area of far peripheral field remaining**

Patient A. Observations

- Eye/head position?
- Use of senses?
- How is task completed?
- Need for prompting?



Patient A. **Conclusions**

Profound Cortical VI

- Tactile exploration of objects
- Limited visually guided behavior
- Not discriminating objects & people by sight
- Some auditory & tactual discrimination

Collaborative approach to education

- Roman CVI Scale

Cortical Visual Impairment

Post chiasmal to occipital lobe damage

- Severely reduced VA and Contrast Sensitivity + VF defects
- **Characteristics**
 - Light gazing or withdrawal
 - Better visual attention for:
 - Moving vs. static objects
 - Familiar vs. novel objects
 - Simple vs. complex environments
 - Difficulty integrating gaze with reach
 - Difficulty integrating looking with listening
 - Poor social gaze
 - Delayed visual (& other) responses
- Dr. Christine Roman-Lantzy

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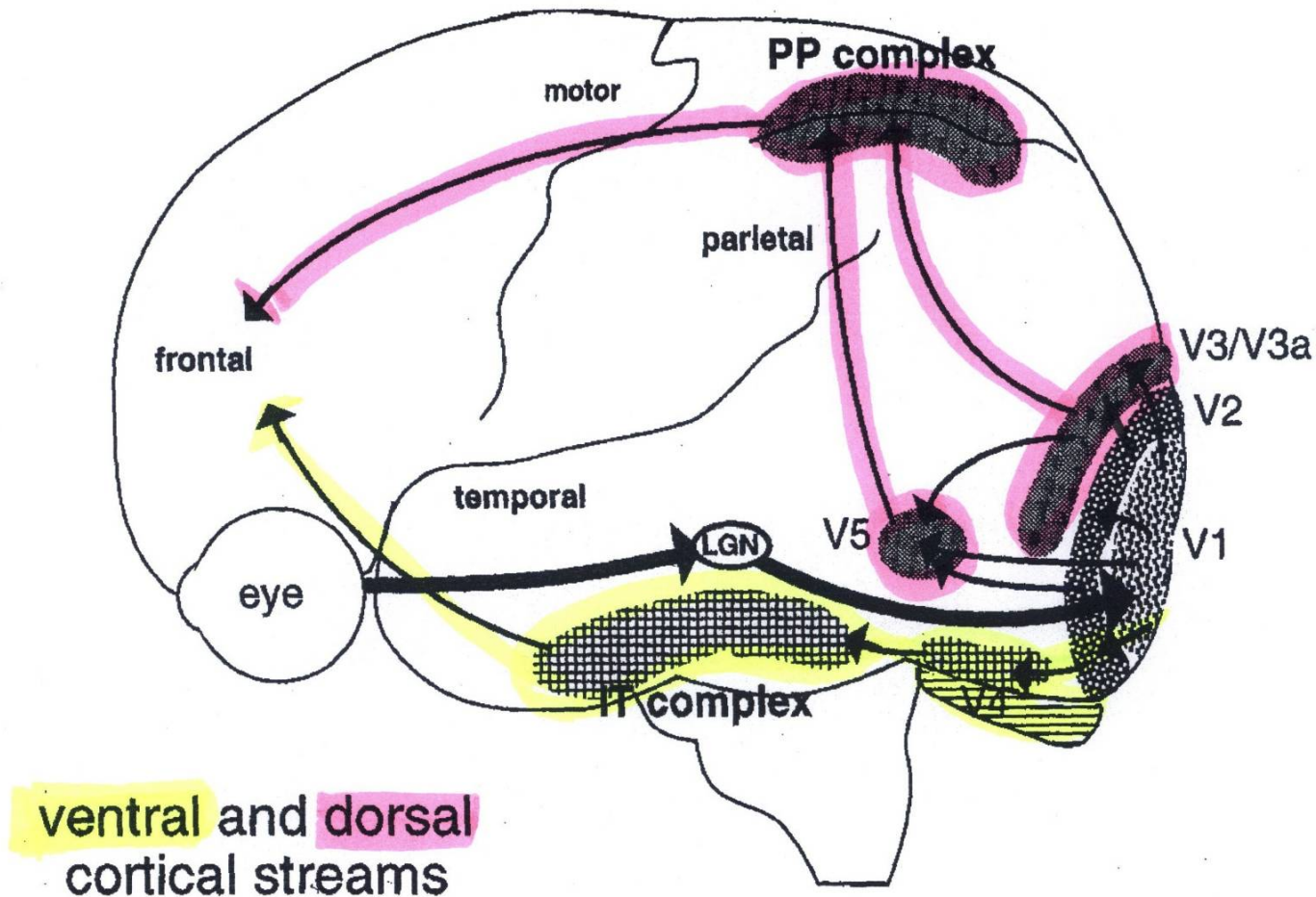
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Cerebral Visual Impairment

Characteristics

- **Post occipital lobe brain damage**
- Complex brain processing difficulties
- Dorsal/ventral stream dysfunctions
 - Prof. Gordon Dutton
 - Dr. August Colenbrander calls “Cognitive visual dysfunction”

Dorsal & Ventral “pathways”

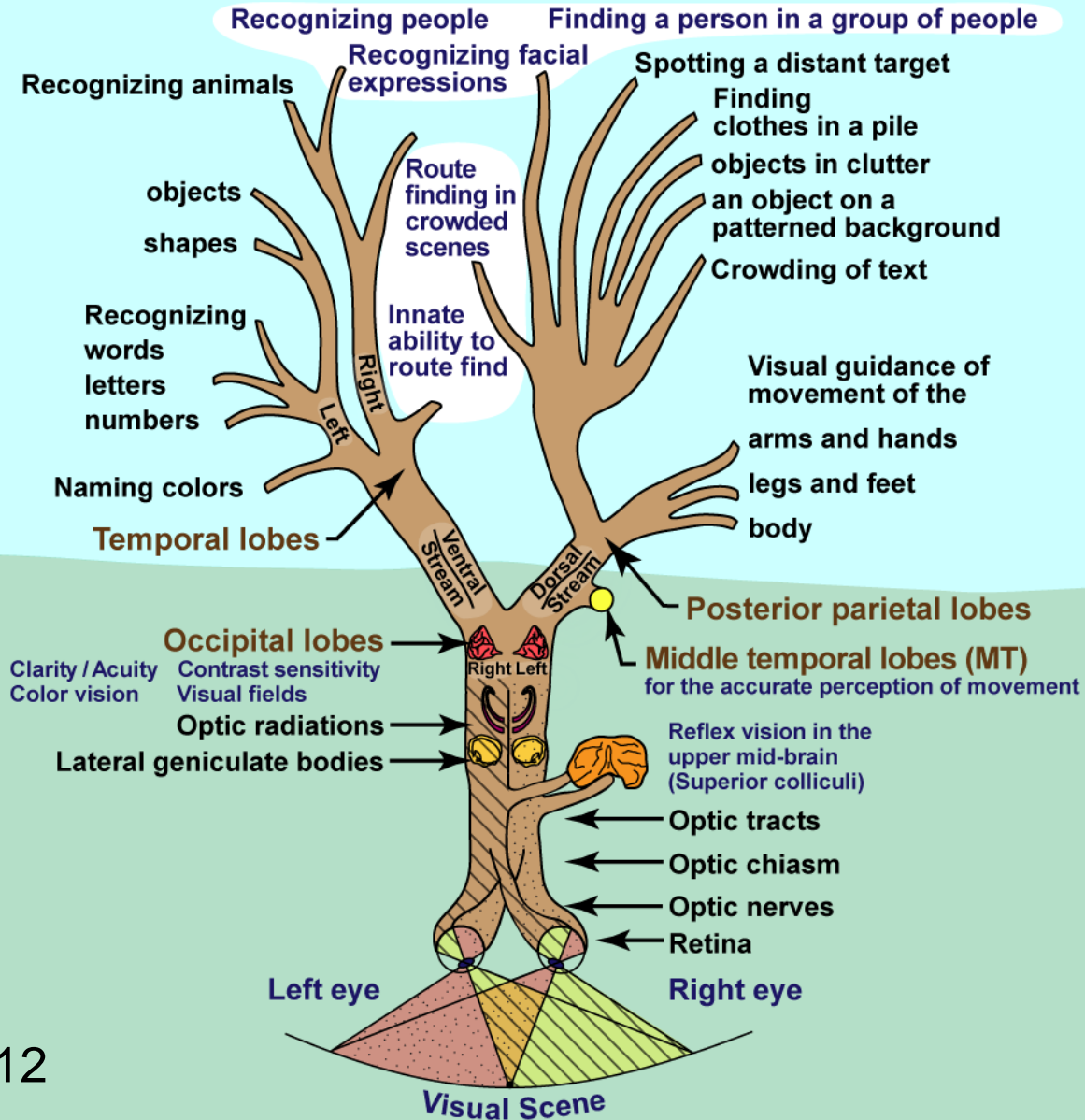


The Tree of Vision

Central visual processing to serve:

Conscious recognition

Search, attention & guidance of movement



Ventral Stream – “What is it?”

Recognition of objects

Occipital lobes

- Receive visual input (primary visual pathway)

Temporal lobes – input from occipital lobes

- Visual “library”
- Words, numbers, shapes, landmarks
- Faces
- Color

Pt. C. **Ventral stream dysfunction**

Age 10 years

Medical- neurological Hx

- Non-accidental trauma at age 3.5 months
- MRI – severe damage to visual cortex and association areas
- Cerebral palsy – left side worse; non-ambulatory

Ocular Hx

- Retinal hemorrhages, resolved
- Nystagmus
- Exotropia
- Optic nerves – temporal pallor
- Myopic astigmatism

Pt. C **Ventral stream dysfunction**

Visual acuity, both eyes, glasses

- “20/100” grating acuity
- Discrepancy with symbol acuity
 - Shapes – 2” height at 3-4”
 - matches better than names
 - Letters – 2” height at 3” distance

Visual field

- Generalized constriction, more on left

Pt. C Ventral stream dysfunction

Visual recognition

- Requires long term practice to identify pictures & letters
- No recognition of transformed familiar object
- Uses color to identify Mayer-Johnson icons (not B&W)
- No recognition of familiar people by sight



Pt. C **Ventral stream dysfunction**

Dorsal Stream Functions Intact

- Visual motor – looks & reaches accurately for small objects, points to images
- Spatial relationships – good

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Dorsal stream - “Where is it?”

Vision for action - visual attention,
visually guided movement

- **Occipital - posterior parietal lobes**
 - Integration of sensory input with attention and during **motor output**, management of visual complexity
- **Feedback from frontal cortices**
 - Motor planning, head/eye movement, visual guidance of movement

Patient M. **Cerebral + Ocular + OM**

Medical Hx

- Premature birth (28 weeks gestation)
- Age 2 months: oxygen deprivation
 - **Changes in occipital cortex on MRI and EEG**
- **Mild spastic diplegia**
- Learning disabilities

Patient M. **Cerebral + Ocular + OM**

Ocular Hx

- Cerebral Vision Impairment (Dx @ 8 months)
- **Nystagmus**
- Strabismus surgery for **esotropia** ~age 2
- **Optic nerve pallor**
- Glasses for **hyperopic astigmatism**

Patient M. **Cerebral + Ocular + OM**

Ocular Findings

Distance Visual Acuity (both eyes)

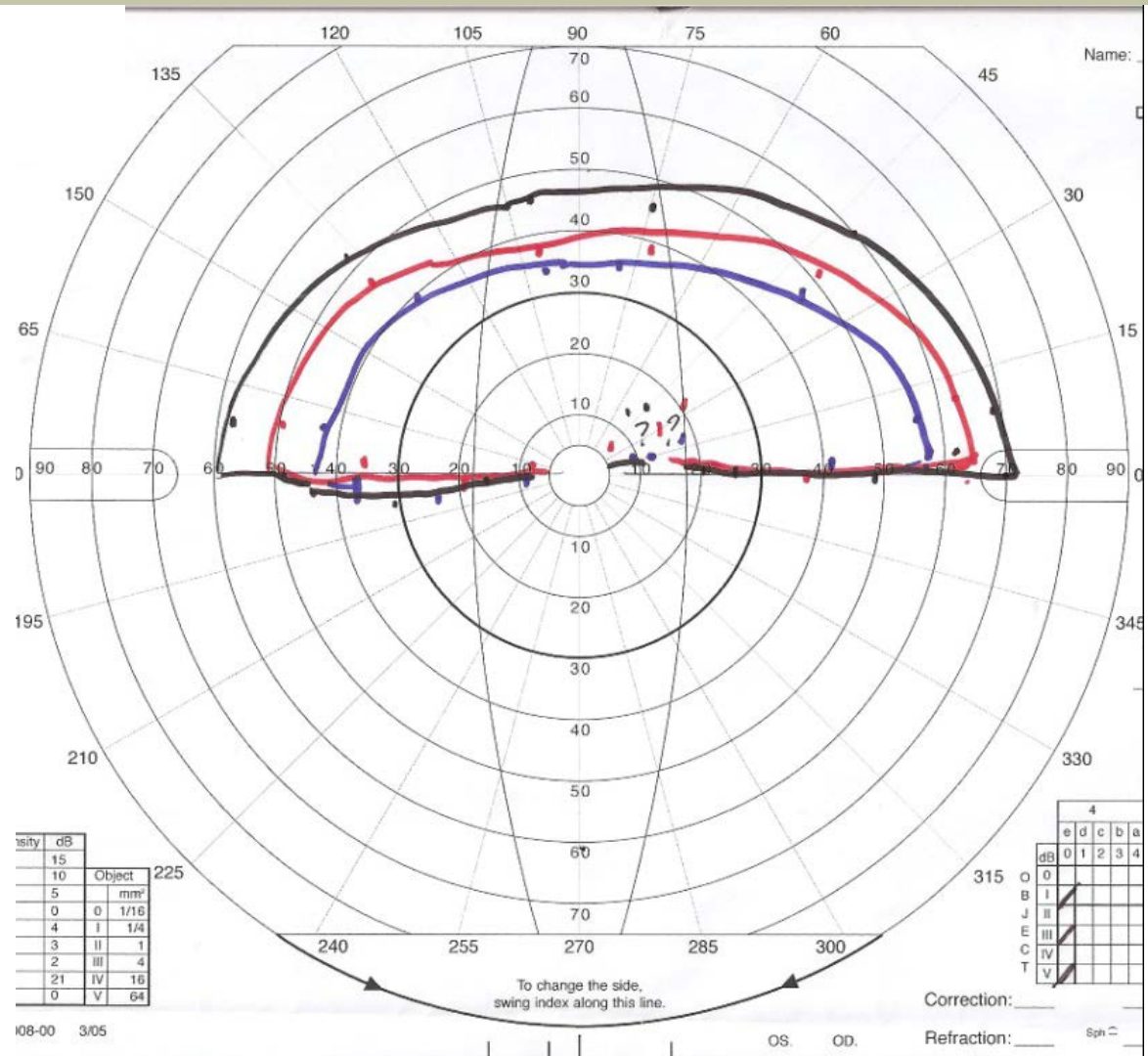
- 20/70 (isolated line)
- 20/150 (whole chart)

Near Visual Acuity (both eyes)

- 1.0M @ 40cm (isolated line)
- 5.0M @ 25cm (whole chart)

Patient M. Cerebral + Ocular + OM

Bilateral inferior field defect



Patient M. Observations

- Visual scanning?
- Integration of visual & auditory sensory input?
- Vision for action?



Patient M. **Cerebral + Ocular + OM**

Cerebral Visual Impairment (Dorsal)

- Impaired vision for action
- Impaired attention
- Impaired visually guided movement
 - Rarely looks down as he walks, esp. on stairs
 - Misses objects close to him while seated
 - Documented *inferior* visual field loss
 - Suspected inferior field neglect
- Impaired vision for complex visual scenes (crowding)
- Visual acuity deficit + strabismus do not account for behaviors

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Patient L: **Cerebral & Ocular VI**

Medical Hx:

- Prematurity (26 wks, 750 g)
- Bilateral germinal matrix hemorrhages
- Ventriculomegaly (greater on right)
- Hypotonia of trunk & extremities

Patient L: **Cerebral & Ocular VI**

Ocular Hx

- ROP (RE worse) – treated surgically
- Very high myopia & anisometropia (RE worse)
 - Staphylomata
- RE amblyopia
 - refractive and strabismic

Patient L: Cerebral & Ocular VI

- Distance acuity with glasses
 - Both eyes viewing:
 - 20/60 full chart
 - 20/40-2 isolated letters
 - (RE: 20/150-)
 - **~12-15 minutes to complete**
 - Behaviors
 - Patient was clearly fatigued
 - Head/body posture and tone
 - Color
 - Voice

Patient L: **Cerebral & Ocular VI**

Neuropsych eval

- Normal IQ
- Processing speed delays and anxiety
- **Driving evaluation (OT)**
 - Visual cognitive assessment in moving vehicle
 - Unable to manage & figure out what to do in complex situation (car tire blowout)
 - In a driving simulator had great difficulty planning and successfully implementing a lane change
 - *“She does not currently have the life skills necessary to cross a busy street, manage herself independently at home or in the community. This suggests that she may have a performance based learning disability.”*

Patient L: **Cerebral & Ocular VI**

Dutton CVI Inventory - DORSAL

Mother & L scored “always” or “often” on DORSAL items:

- Visual field/visual attention when moving
- Impaired visually guided movements
- Impaired perception of movement
- Difficulty with complex visual scenes
- Difficulty in crowded environments
- Impaired visual attention

Patient L: **Cerebral & Ocular VI**

Dutton Inventory - VENTRAL

Visual Recognition

- Mother and daughter disagreed on 6/7
- L. reported an inability to recognize close relatives in real life and in photos, and confuses strangers for familiar people.

Does this mean that daughter compensates for ventral problem without Mother's awareness?

Patient L: **Cerebral & Ocular VI**

Conclusions

- Ocular VI is **NOT** the primary cause of L.'s visual function deficits
- Ed. team and eye doc. **DID NOT** identify signs consistent with Cerebral VI
- MRI + exam observations + Dutton Inventory support Dx of Cerebral VI (dorsal + ventral)

Summary

Visual Sequelae of Pediatric Brain Damage

A complex combination of abnormal visual behaviors due to brain damage, in subcategories that **CAN** co-exist with ocular & ocular-motor categories.

Summary

Approach to care and education is emerging.

- Diagnosis and management require a collaborative approach. (medical & educational)

Eye care providers need additional tools & training to identify Cortical & Cerebral VI

Individuals with Cerebral VI may not have access to vision-related services

- TVI, O&M may not be most appropriate to assume primary responsibility for ed plan.

TVI, O&M have significant and necessary contributions to development of ed plan.

Summary

Future Directions

- Recognition of the diversity of patients with visual impairment secondary to brain damage by medical & educational communities
- Develop an agreed upon classification scheme
- Determine appropriate testing and instructional methods to meet the needs of individual students
- Expand training of all vision educators, medical and related service providers

Resources

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