

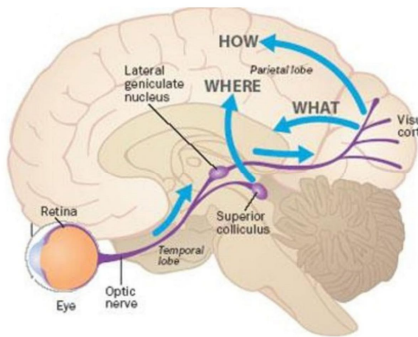
## Brain Injury and Vision

The visual process is tremendously complex. So much neurology is involved; therefore, so much is exposed following brain injury. It is not possible to anticipate *all* of the problems which may result following a brain insult (such as a stroke, trauma, or an infection of the central nervous system). However, the array of possible problems may come to light with an overview of the Visual Pathways.

### Where is “Vision” in the Brain?

Visual discrimination/ recognition, the ability to “make sense” of things, is largely impacted after brain injury. This visual information processing takes place in **all four lobes of the cerebral cortex**. Visual data leaves the eyes, organizes in the midbrain (*thalamus*) and enters the **occipital lobe** (at the “*striate cortex*”). After initial re-organization in the “primary visual cortex,” visual data is transferred to **associative** cortices to help us make sense of the world:

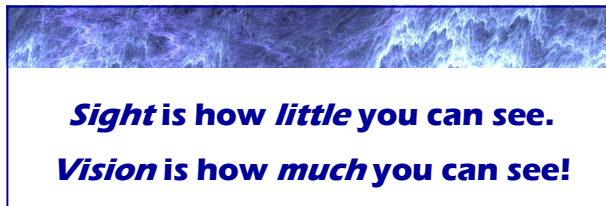
- Data are carried toward the **parietal lobe** for spatial processing, “*WHERE is it?*”
- Data are carried toward the **temporal lobe** for identification, “*WHAT is it?*”
- The **frontal lobe** supports visual-motor planning, such as, “*HOW do I get there? and WHICH should I manage first?*”



## Lower Visual Centers in the Brain

While 90% of visual input reaches the cortex, 10% of visual information is gathered and used “subcortically”: It never reaches our conscious awareness. This visual information travels from the eyes to the **midbrain**. This visual pathway supports our balance, orientation, and our sense of visual stability.

Patients who suffer cortical visual loss after brain injury (e.g., “hemianopia”) can develop “Blindsight,” an ability to see and respond to visual information without it ever reaching consciousness. *This can even be trained!*



### Oculomotor Impacts of Brain Injury

Most patients’ visual challenges are not limited to “sight,” the ability to identify small images. In a sense, *sight* is about how *little* you can see... while *vision* is about how *much* you can see! Vision requires the eyes to aim accurately *as a team* for single vision, to maintain stability, focus clearly, and navigate the visual field.

The brain directly manages motor control over the eyes with six (6) of the twelve (12) Cranial Nerves (CN). *That’s half!* They support both *sight* and *vision* by:

- Carrying visual data, eyes to brain (CN II)
- Controlling eye movement (CN III, IV, VI)
- Controlling eyelids (CN III, VII)
- Carrying eye sensations (CN V)

The control centers for these nerves are in the brainstem. Thus, eye movement control is frequently “unhinged” post-injury (especially following whiplash!).

## Tunnel Vision following Brain Injury

After brain injury, “Tunnel Vision” is a common experience. While the retina may be healthy, the brain is not prepared to gather and organize information from a broad area. As part of the “fight or flight” response, *blood flow is diverted from the peripheral retina*. This protective mechanism may last long after the threat is removed, affecting:

- **Orientation:** feeling “lost in space” or insecure in one’s surroundings.
- **Balance:** feeling unsteady, less coordinated, (increasing the risk for subsequent injury).
- **Eye teaming:** binocular vision suffers, especially when sustained, at near-point (e.g., “*convergence insufficiency*”).
- **Eye tracking:** impacting *saccades* (eye “jumps” used in reading & scanning), *smooth pursuit* (ability to track moving targets), & *fixation* (ability to hold eyes steady).
- **Simultaneous visual info processing:** Tunnel vision creates difficulty seeing the world as a whole. With impaired orientation and concentration, patients struggle to piece things together. This evokes confusion, fatigue, and headaches.
- **Spatial memory:** reduced sense of orientation impacts incidental recall for location (e.g., *Where did I leave my keys? My car? My glasses?*)

### Neuro-optometric Visual Rehabilitation

With a comprehensive, holistic approach, Neuro-optometric Visual Rehabilitation helps patients reclaim control over visual input skills and multisensory visual information processing. As symptoms abate, impacts are realized *far beyond the visual process!* Common results include improvements in: Balance, movement, motor planning, coordination, sustained visual attention, concentration, interest in reading, academic skills, athletic performance, memory, focus, organization and planning.

## How Neuro-Optometry Can Help

- ◆ **Lenses** and/or **colored filters** may alleviate unnecessary stress, helping patients feel grounded and stable, in support of recovery.
- ◆ **Lens prescriptions** may stabilize focus, eye strain, reduce headaches, fatigue, and help resolve double vision.
- ◆ **Prism prescriptions** may assist patients with balance and walking.
- ◆ **Syntonic phototherapy** (color therapy) helps patients gently expand the peripheral visual field, to overcome the myriad symptoms of tunnel vision.
- ◆ **Neuro-optometric Visual Rehabilitation (NOVR)** supports the patient's ability to reclaim control over eye aiming, eye teaming, focusing, visual information processing, and multisensory integration between Visual skills and the full array of:
  - ◆ Input senses: Vestibular (balance), Auditory, Tactile, Ocular Proprioception (eye-feel), and
  - ◆ Output skills: Gross motor, Fine motor, Oculomotor, Speech, and Visual Perceptual Processing.
- ◆ With **NOVR**, Visual Perceptual therapy provides the *scaffolding* which helps the patient re-establish an organized, stable foundation.
- ◆ **NOVR** supports: Body organization, Spatial organization, Visual Spatial Memory, Visual Sequential Memory, Tachistoscopic Memory (at a quick glance), Orientation, Visual Motor planning, Eye-hand Coordination, and Visual Perceptual problem solving.

## Visual Impacts of Concussion

Visual problems may result in **Avoidance**, **Reduced Performance**, or **Physical changes**.

### Be on the lookout for these tell-tale signs!

- Eye strain and/or headaches
- Episodes of dizziness; motion sickness
- Visual fatigue
- Intermittent blurry vision
- Double vision, especially at near-point
- Light sensitivity; flicker sensitivity (indoors)
- Short attention span for reading
- Must re-read to understand
- Loss of place: skipping or re-reading words or lines
- Impaired cognitive abilities on visually-dependent tasks
- Impaired reaction time
- Reduced coordination on previously automatic tasks
- Reduced athletic performance, feeling "out-of sync"
- Disorientation, feeling "lost in space"
- Balance affected, feeling unsteady on feet
- Moodiness, irritability, feeling overwhelmed



# Neuro-Optometric Care following Concussion & Brain Injury



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