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PRIMARY eye care

Post Concussion Vision Syndrome

Vision is a dynamic interactive process of motor and sensory function mediated by the eyes for the purpose of simultaneous organisation of posture, movement, spatial orientation, manipulation of the environment and, to its highest degree, perception and thought.

When vision is working well, it guides and leads; when not it interferes.

Visual Acuity is a measure of how clearly we see things but visual processing is about accurate input of the visual information, with integration of sensory and proprioceptive information. These combine to influence and ultimately guide motor output.

The eyes see things in 2D but the brain sees things in 3D.

Concussion is a brain injury caused by movement of the brain within the skull either by direct blow to the head, face, neck, or elsewhere on the body with an 'impulsive' force transmitted to the head (whiplash effect).

It is important to note that not all patients who suffer a concussion will report a direct blow to the head.

A strong jolt to the torso or neck can also result in the impact 'radiating' up into the brain and still causing the movement inside the skull needed for a concussion.

The movement of the brain causes damage that changes how brain cells function, leading to symptoms that can be physical, cognitive or emotional.

The rate of concussion in New Zealand is increasing every year. The cost to ACC in the 2012-2013 year was $66.5 millions. Within 4 years that figure increased to $88 millions and there were almost 5000 more concussion injuries lodged with ACC.

Figures from the USA show that people who are at high risk of suffering a concussion are those who have had a concussion within the previous six months and, interestingly, teenage girls. In high school sports in the USA the second most common group presenting with a concussive injury are female soccer players. This is staggering in a so-called 'safe' sport.

Recent literature suggests the high risk of teenage girls suffering a concussion is multifactorial and can be related to differences in musculature and skull thickness in comparison to boys.

The rate of concussion in New Zealand is increasing every year.

BUT eye skills have also been noted as an important factor as well.

The damage to the brain with a concussion isn't demonstrable with modern day imaging so diagnosis and improvement is often tracked based on symptoms.

Common symptoms following a concussion are;

- Headache
- Brain Fog, Inattention
- Dizziness
- Nausea
- Fatigue
- Emotional Issues/Mood changes
- Memory issues
- Sleep Problems
- Light Sensitivity

The eyes are the tip of the iceberg when it comes to vision. They are the receivers, but the brain is the processor and the most important part of the visual process.

80% of optic nerve fibres go to the visual cortex for higher order processing. That leaves 20% that go to other parts of the brain, 18% goes to the midbrain (superior colliculus) for spatial orientation and 2% travel to other areas such as the amygdala and hippocampus to regulate body and mind functions.

Occipital lobe injuries are an obvious brain injury to affect the visual processing cortex but other areas of the brain can also have a visual outcome.

The superior colliculus co-ordinates eye movements in relation to the body and the head. It receives information for this task from both auditory visual cues along with information from the spinal cord and cerebellum.

The posterior parietal cortex is involved in mapping where you are in space and helps with attention and hand-eye co-ordination. The frontal lobe is critical in executive function and initiating eye movements.

The cerebellum is involved in refining eye movement and is also important for balance and equilibrium.

Injuries to the brain stem can cause severe light sensitivity.

The pulvinar is important in the initiation of saccades and visual attention as it has input from the visual cortex, superior colliculus and posterior parietal cortex that strengthens the visual link.

Studies vary but anywhere from 50-90% of individuals have a visual dysfunction after a TBI. The most common visual symptoms following a concussion are;

Blurred Vision 46%

Double Vision 30%

Headaches 13%

Visual Field Defects 35%

Cranial Nerve Palsy 33%

Visual symptoms can often be non-specific and confused with other symptoms. Whilst most patients don't often complain of blurry or double vision they may comment they struggle to read. There is often too much visual noise and words can swim around on the page. Other complaints can vary but may include bumping into things, feeling nervous in crowded places, a new dislike for going to the supermarket of mall and the person may feel like they are falling from time to time.

Symptoms of concussion can often be quantified with the use of questionnaires. These same questionnaires are used during treatment to track progress and improvement.

The University of Pittsburgh Medical Centre (UPMC) has six clinical trajectories following concussion. They all have visual overlap with their symptoms:

Cognitive/Fatigue – Decreased concentration, difficulty learning or retaining new information and increased fatigue as the day progresses

Vestibular – Balance centre – can affect the ability to interpret motion and co-ordinate head and eye movements or stabilize vision with head movement

Ocular – Difficulty tracking or moving one's eyes

Post Traumatic Migraine – Headaches, nausea and sensitivity to light or noise

Cervical – Can get ongoing headaches

Anxiety/Mood – Anxiety and trouble turning thoughts off

Visual Assessment

Visual Acuity and Refraction:

Small refractive errors can be much more important to correct in a post concussive patient than normal. A patient who could tolerate low amounts of myopia (-0.50) or hyperopia (+0.50) before a brain injury may no longer be able to cope with this after a concussion. Often such people benefit from visual correction.

Visual Acuity is one of the most important visual skills, such that it can impact on the function of other processes such as ocular motilities, accommodation and binocularity. It forms the foundation of visual processing.

It is important to note that the majority of patients who suffer a concussive head injury do not show a reduction at all in their visual acuity. It is for this reason that often vision isn't considered an important part of the rehabilitation process. An examination by an optometrist that focuses on more than just static visual acuity is important to put all the pieces of the puzzle together.

The neural processing of vision is more than just letters on a chart and practitioners need to keep in mind that even with 6/6 visual acuity other vision problems may exist.

Accommodation/Focusing:

This is important for clear vision in a dynamic environment with varied working distances. It is necessary to measure both the amplitude or amount of accommodation and also the speed and ability of the accommodative system to change its focus on objects in different areas of space (distance to near and vice versa).

Fixation:

It is important to have steady fixation on an object in space to be able to see it clearly. Those patients who have nystagmus do not have a steady point of fixation unless at their null point. Patients must have normal fixation to be able to have normal higher processing skills such as saccades and pursuits.

Ocular Motilities:

Saccades - These are rapid eye movements that allow fixation to move between different targets in space. They are both voluntary and involuntary in nature. An example of involuntary saccades would be reacting to an unexpected stimulus in the peripheral environment such as a bright light or a loud bang. A voluntary saccade is the type of eye movement required for reading jumping between words.

Pursuits - These are smooth eye movements primarily used for tracking.

Binocularity - This is the ability of the visual system to have two eyes maintaining fixation on a target that results in single vision without suppression. Important skills to assess in this area are stereopsis(3D), near point of convergence and vergence reserves (range of disparity in image location before diplopia appears).

Convergence Insufficiency - This is the most commonly noted sign of post concussion vision syndrome. It results in an inability of the two eyes to converge to read up close. This lack of 'team work' results in a loss of binocularity. The eyes are misaligned and result in eyestrain, headaches and blurry vision.

The Convergence Insufficiency Treatment Trial (CITT) showed the best treatment for this deficit is in-office supervised vision therapy with home exercises also prescribed. 75% of patients in the CITT study receiving this treatment had either full correction or marked improvement in 12 weeks.

Given the high demand on our near vision in our day to day life, and with an increased reliance on devices, this is a critical area to diagnose and treat.

Other areas that can be assessed are;

Spatial Localisation
Visual Midline
Visual Attention

Spatial Localisation is the reference of a visual sensation to a definite object in space. Accurate spatial localization can be tested by having the patient reach out to touch your finger with their finger in different positions in space.

Visual Midline Shift Syndrome is a phenomenon that results in a shift of the midline for the patient. Their 'centre' is different and can result in patients complaining that the floor is tilted, walls can shift and move and the patient leans to the unaffected side to 'balance' themselves in their new environment.

It can be quite simply tested by asking the patient to identify when the examiner's finger is in the middle of their vision.

Treatment

Spectacles:

Low prescriptions or prescription changes should be dispensed as needed.

Yoked prisms can also be used – the concept behind these is to help to expand the space for the patient.

Tints can also be used to help with light sensitivity and calming the visual stimulus.

Binasal Occlusion is also used:

The reason this helps is unsure but it is thought it works by limiting the overlapping visual areas between the two eyes until better binocularity is achieved.

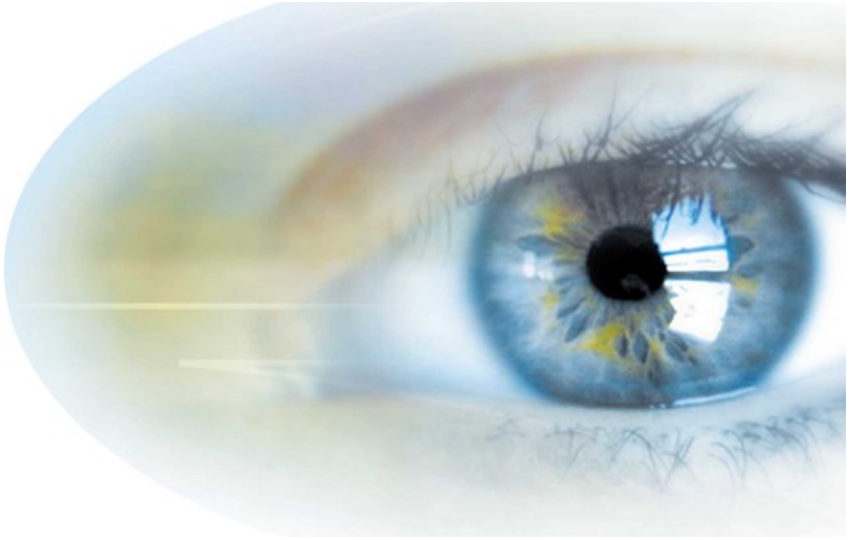
Neuro-Optometric Rehabilitation:

Vision Therapy can be very successfully used to help improve the following areas -

Visual Function
Oculomotor (accommodation, binocularity)
Motor Function
Bilaterality (eye-hand co-ordination, balance)
Attention (especially visual attention)
Central-Peripheral Integration
Ability to filter and integrate multiple stimuli

The point of vision therapy for these patients is to improve accommodation and convergence skills, facilitate anti-suppression, ensure smooth ocular movements and enhance peripheral vision.

It is important to concentrate on these skills monocularly before proceeding binocularly. Each eye must be able to contribute equally to the activity for symptoms to resolve.



Sideline testing

The King Devick test is designed to test the speed and accuracy of saccadic eye movements. It is a test that has long been used in optometry for that purpose but more research is coming to light of its benefits in sport at the sideline to help make a 'remove from play' decision. It takes less than 1 minute to administer and baseline tests are compared to a test after a potentially concussive event. If the time taken to complete the post-event test is 5 seconds longer or there are 2 or more errors made the advice is to remove the player from the field and seek further investigation.

The recently created VOMS (Vestibular/Ocular-Motor Screening) tool is a standardized test for all professions to use in assessing brain injury and to compare responses over time.

The patient is asked to score headache, brain fog, nausea and dizziness after each activity. The activities measured are smooth pursuits, horizontal and vertical saccades, horizontal and vertical vestibular-ocular reflex, near point of convergence and accommodation.

The concept behind the strict testing protocols is that no matter who the practitioner, results are comparable based on the score at each visit.

Neuro-Optometric Rehabilitation is a useful tool in what should be a multi-disciplinary approach to concussion and other traumatic brain injury rehab. There is no one fix for these patients in any profession and each patient presents a new set of challenges.

Vision therapy is increasingly seen as an area that is important to help these patients on an international stage however it is still somewhat under-utilized in New Zealand.

ACC recognizes that optometry is an important option for concussion rehabilitation and concussion service providers are able to refer to any optometrists (up to 1.5 hours of time) for assessment of visual function related to a claimants injury. Should specialist optometric assessment/treatment be needed then the concussion service provider can request that it be provided under the claimant's ACC cover.