Optometrys' Role in the Rehabilitation of Closed Head Trauma Patients

Paul R. Kennedy
Senior Project
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Introduction

The rehabilitation of closed head trauma patients is one of the fastest growing specialty areas in optometry. Due to the countless advances in medical technology, CHT patients are living longer and have an even greater need for rehabilitation. "It is estimated that approximately 75% of the patients who survive head trauma and strokes require some form of rehabilitation."[1] The major goal of rehabilitation is to make the patient more independent so they can re-enter their former occupation or be trained for a new one. Optometrists are uniquely qualified members of the rehabilitation team who can co-manage the overall rehab. of the patient by minimizing visual problems as well as consulting other members of the rehab. team.[1]

Overview of Closed Head Trauma

In order to effectively diagnose and manage the numerous visual and non-visual complications that are secondary to head trauma, it is helpful to have some general understanding of what kind of trauma has occurred. There are many forms of head trauma that cause a variety of complications depending on the area of the brain affected.

"Closed head trauma (CHT) occurs from a blow to the head that does not cause a direct pathway from outside the soft tissues of the head to the brain."[1,2] Cerebrovascular accidents are included in the CHT category. CHT is the most common form of head injury seen by optometrists. There are two forms of CHT: acceleration and deceleration type injuries.[2]

Acceleration or "coup" injuries occur when the head is relatively still and is struck by a faster moving object. Deceleration (counter-coup) type injuries result from the head colliding with or being slowed down by another object or force.[1] This sudden stop cause the brain to bounce back and forth within the skull. Counter-coup injuries will generally cause damage at the point of the impact and the point directly opposite the impact.[1,3]

Brain Function

In order to manage brain injury patients, the optometrist should have an understanding of the brain and its' functioning. There is no easy or absolute way to localize the functions of the brain. Brodman has made the most accurate and accepted mapping of brain functions.[1,3,4] Even though it has been shown to be valid; functions vary greatly between individuals.

Frontal lobe

"In general, the frontal lobe is involved with motor control and motor planning."[1] It is also involved in the initiation of saccadic eye movements, production of language, personality, attention span, concentration and abstract reasoning.[3]

Temporal Lobe

This area contains the primary auditory cortex which is involved with complex learning, integrating auditory stimuli and forming an appropriate responce.[3] It is also believed to be active in memory recall and object recognition.[1,3]

Parietal Lobe

The parietal lobes are important for processing tactile and proprioceptive information. This allows for a sense of position and movement of body.[1,3] Damage to these areas will also affect expression of ideas through language.[3]

Occipital Lobe

The occipital lobes are the visual sensory and association areas of the brain. Damage to these areas will likely cause significant visual field loss and difficulty with the initiation of smooth pursuit eye movements.[1]

Cerebellum

The cerebellum is associated with the vestibular system and adjustments in posture to gravity. It also coordinates voluntary movements.[3]

Midbrain

"The superior colliculi of the midbrain are responsible for visuomotor coordination and body movements to help in eye fixation."[3]

Cerebral Dominance

The two hemispheres of the brain have areas of dominance in certain areas of function, but are not totally specialized.[1,4] The left side of the brain sequentially processes information and is more dominant in language comprehension and function. It also controls motor activity for the right side.

The right hemisphere processes information simultaneously. It is responsible for analyzing spatial information, controlling visual perceptual skills, holistic problem solving and motor control of the left side.[1,4]

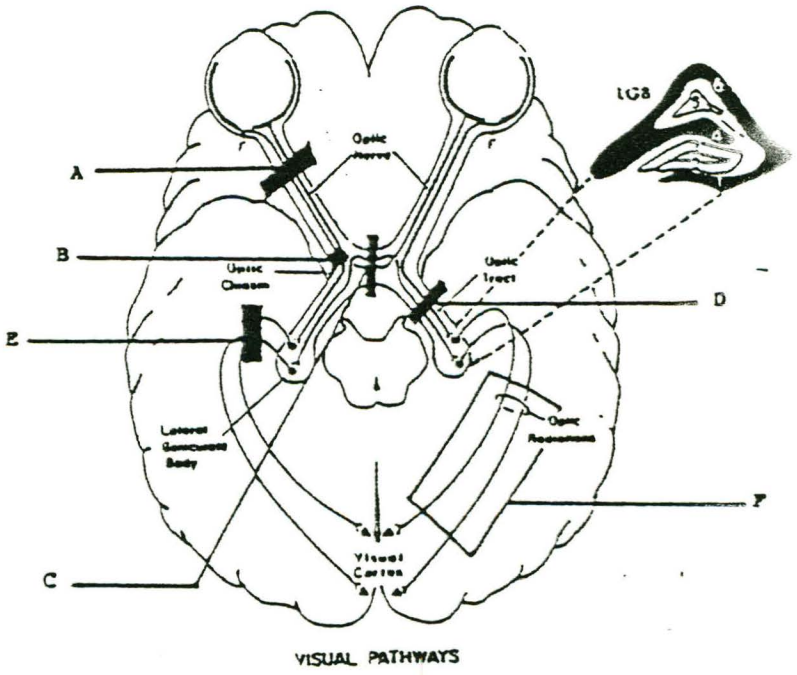
Visual /Ocular Complications

Post traumatic vision syndrome (PTVS) is the current name being given to the collection of visual deficits found following CHT.[3] The presentation of PTVS is based on the area of the brain that is damaged. Because no two brain injuries are exactly alike, the presentations vary greatly. The visual system has an impact on all aspects of life. The entire rehabilitation process becomes much more difficult if the visual system is not efficient. There are a number of common visual difficulties that present in CHT. It is the optometrists role to detect and manage these problems.

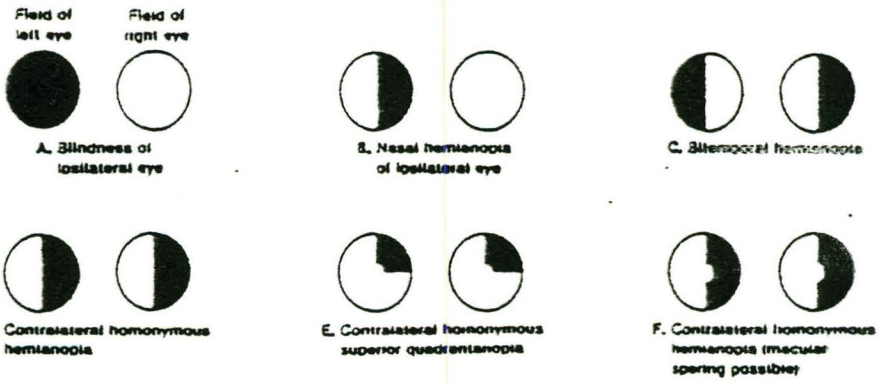
Visual Field Defects/Visual Neglect

Visual field deficits are probably the most common and functionally significant visual problem found in CHT.[1] Actual field loss shows up in a variety of forms, depending

Diagram A[2]



VISUAL PATHWAYS



Visual Field deficits caused by lesions at different points in the visual pathway.

on what area of the visual tract is damaged [see diagram A[3] and table 1[2]]. Visual field loss is usually irreparable and must be differentiated from visual field neglect.[1,3]

table 1[2]

Defect	location
Central defects	Optic Nerve
Centrocecal defects enlarged blindspot	Optic Nerve
Bitemporal defects	Chiasmal lesion
Noncongruous homonymous hemianopsia	Optic tract or lateral geniculate body
Superior quadrantopsia	Temporal Lobe
Inferior quadrantopsia	Parietal Lobe
Homonymous hemianopsia with macular sparing or splitting	Occipital Lobe

Visual neglect occurs when a patient is unaware of a field defect. These patients will present with a history of running into things. Neglect may initially show up as a field loss, but is different from a loss in that it can usually be improved by making the patient conscious of the deficit.

Binocular Problems

Accommodative dysfunctions are found in a majority of CHT patients and are often a detriment to the rehab. process. Although the reason for this decrease in accommodation is poorly understood, it is common to see children and young adults under age 35 requiring an add at near.[1]

Because head trauma often affects cranial nerves III, IV and VI, it is not surprising that exo, eso and hyper deviations are common.[1,5] Patients usually have a tendency to go more exo in posture. Strabismus can present with or without comitancy. Due to the inability of adults to develop amblyopia or anomalous retinal correspondence, diplopia and confusion are commonly seen.[1] A generalized decrease in fusion is also common and usually presents as a convergence insufficiency.[6]

Oculomotor Problems

CHT patients usually have poor fixations and pursuits. Jerk nystagmus is also possible either horizontal or vertically.

Visual Perception Problems

Patients with CHT often have visual imperception problems including: spatial relations, figure ground, visuomotor integration and right-left discrimination.[7] Other common presentations are agnosia (difficulty in object recognition) and apraxia (difficulty manipulating objects).[1]

Some visuomotor problems, such as figure copying and assembling patterns, show up differently depending on which hemisphere of the brain is damaged. A left brain injured patient will produce a more simplistic structure lacking detail. The right brain injured patient will produce a more complex structure that is asymmetric or disorganized.[4]

Perceptual problems can be seen with damage to almost any area of the brain. They are complicated cognitive functions that require the integration of information from all areas of the brain. [1,4]

Other Ocular Manifestations

Decreased blink rate, lagophthalmous, and anisocoria can also be seen with CHT.[1,3,5] Depending on the location of the injury in relation to the optic tract, pallor of the optic nerve head can also be seen secondary to atrophy.[8]

Non-Visual Complications

Language/Speech

Language problems are another major obstacle in the rehabilitation of brain injured patients. "*Aphasia* is the general term used to describe decreases in speech and language function secondary to neurological damage."[2] Aphasia is especially common with left hemisphere damage. Although complete recovery is often possible, up to 50% of CHT patients have some residual speech impairment.[4]

Expressive aphasia occurs when the patient understands language, but cannot respond. Patients will often have to spell or draw out responses. This is usually associated with damage to Brocas' area of the frontal left hemisphere.[2,4]

In receptive aphasia, the patient can speak, but has difficulty understanding language. Damage to Wernikes' area in the temporal/parietal lobe is usually responsible.[2,4] If both Wernikes' and Brocas' areas are affected, global aphasia can result.[2,4]

Olfactory

"It is estimated that approximately 7% of CHT patients suffer some loss of smell following the injury."[4]

Motor Planning

"Motor planning is defined as the ability to organize and sequence thoughts and actions."[4] This is a very difficulty task for most CHT patients, due to dysfunctions in: sequencing, impulsivity, attention span and memory.[4]

Motor / Physical Problems

Along with visual and cognitive rehabilitation, most CHT patients are usually receiving some form of physical and occupational therapy. Depending on the extent of the brain injury, patients may present with a number of different motor/mobility problems ranging from parasthesis to complete paralysis of one or more body parts.[1,4,6,7]

Evaluating CHT Patients

In diagnosing and treating patients with post traumatic vision syndrome, ODs must be able to perform a complete primary care evaluation, as well as make the proper consults for specialty care: binocular vision therapy, contact lenses, low vision and perceptuomotor evaluations. In addition to watching out for the common visual presentations of PTVS, there are also several modifications to the traditional exam which make the diagnosis and management of PTVS easier and more efficient.[1,5,9]

Case History

The case history of a CHT patient begins as soon as the patient walks into your office. It is important to take note of any limb paralysis, gait/mobility problems, head tilts or neglect.[9] If the patient has memory or language difficulties, it is often necessary to rely on the patients' family and friends for a large part of the case history.[2,3,9] It is helpful to get an early impression of the patients' memory and language skills by asking simple recall type questions (ie. "What did you have for lunch today?").[3,9]

Due to the possible systemic problems associated with CHT, all medications and their potential adverse effects should be noted. It is also a good idea to find out what other forms of rehab. the patient is/was receiving.[3,9]

The most important part of the case history in CHT patients is determining the patients' goals. It is necessary for the doctor to know what the goals of the rehabilitation are, in order to determine whether or not they are attainable.[9]

Subjective /Objective Testing

Brain injury patients can present with a number of complications which require alterations to the traditional optometric exam. Subjective information can be difficult to obtain depending on the condition of the patient. In many cases, the practitioner may have to go on objective findings alone.

Refracting CHT patients can be difficult. If visual field loss is causing a head tilt or posture problem, a trial frame refraction may be necessary.[2,9] A thorough binocular vision evaluation is essential in every CHT exam. It's important to look for any fusional or accommodative deficits. If a phoria or tropia is present, it should be checked in all fields of gaze for diplopia and comitancy. The Parks three step and Hess-Lancaster tests are often helpful.[2,3,9]

Visual field testing may be difficult in CHT patients. Because of problems with fixation and attention, simple testing procedures are usually the most reliable. Confrontations, amsler grid and manually plotted VFs usually produce more accurate results than automated fields.[2,9]

Optometric Rehabilitation

Optometric therapy in CHT patients involves the management or co-management of ocular disease as well as prescribing therapeutic lens systems, prisms and low vision devices.[5] These approaches must be integrated with physical, occupational and cognitive therapy.

Refraction

In treating patients with brain injury, the first step is to get the best central VA possible, with the appropriate add for near work. It's important to make sure the patients' glasses are functional as well as accurate. Larger frames with a wider near segment usually give the best field of view. Progressive add lenses are a poor choice for patients with field loss.

Vision Therapy

Binocular and visual perception problems can be a severe detriment to the entire rehab process. It is important for the optometrist to detect these problems and refer the patient to the proper specialist. Vision therapy for CHT patients is often a time consuming and frustrating process. "Brain injury patients are easily depressed and are quick to get angry and quit."[3] It is important to keep the therapy demand at/or near their performance level.[3]

Therapy is usually started with strengthening the basic oculomotor, fusional and accommodative skills, and gradually working into more complicated integrating exercises. Because these patients are easily frustrated, group therapy will sometimes help show the patients that they are not alone in their frustration.[3,4]

Visual Field Compensation

Visual field loss can also be a detriment to the total rehab. process. Field loss, especially when combined with diplopia, can be extremely confusing for the patient.[9,10] It can create a compensating head tilt or hunched over body posture. It has even been known to cause nausea and vomiting in severe cases. Although field loss is usually permanent, there are several ways to help patients compensate for their field loss and live a normal life.[10]

The first step in getting patients to adapt to field loss, is to make sure that they are conscious of it. This is done through the use of tracking and scanning exercises, which force the patient to recognize objects in the missing field.[3,4,9] If balance or posture problems are present, it is often necessary to start the training with the patient lying on the floor. As the patient progresses, the training can be done in sitting, standing and moving positions.[3,9]

The homonymous hemianopsia is the most common field defect found in CHT, and will often cause a shift in the patients' visual midline. A midline shift can cause severe spatial disorientation. The patient may report that his/her visual world is slanted or moving. Bilateral yoked prisms with the base toward the field loss has been shown to shift

the midline back to center.[3,9,10] Base down yoked prism will occasionally help patients with hunched over postures.[3]

Small amounts of base in prism will often brighten up and expand a patients' decreased visual space. Not every patient responds to this therapy, but the ones who do usually notice the difference immediately.[3] Binasal occluders also have a similar effect. "Low plus lenses can also expand space as they move focus outward (used alone or in combination with BI prism)."[3]

Prisms are not used to replace lost field, but are usually used temporarily as a crutch. They improve posture enough to help the patient adjust and progress with further rehab.[3,9] Press-on Fresnell prisms are a good temporary choice because they are relatively inexpensive and easy to use. Patients should be warned however; these lenses will likely cause a 2-3 line drop in visual acuity.

Clip-on mirrors and back surface mirrored lenses have also been shown to be effective in compensating for missing VF.[10] These devices are used to actually superimpose areas of the scotomatous field onto the seeing hemifield. Although these devices don't actually replace the field, they do increase the awareness of objects in that space.[9,10] Some of these techniques may work better than others, depending on the patient. It is important to let patients know that these options are available, in order to make it easier for them to adapt to their field loss.

Conclusion

Even though every primary care optometrist is not going to feel comfortable managing CHT patients; they should still make the proper referrals to someone who will. Optometrists must communicate with the other health care professionals in the rehab. process. It is the ODs' job to inform them of the impact that visual loss may have on the patients' total rehabilitation.

Optometry can play a major role in the rehabilitation of CHT patients. "Full scope optometric therapies by the primary care OD can provide the perfect complement to the team approach which is vital to the complete recovery of the CHT patient."[9] Most of the spontaneous recovery following traumatic brain injury occurs within the first six months.[2] The sooner the patients' visual problems are managed, the smoother the entire rehabilitation will go, and the better the chance for the patient to resume a happy and productive life.

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Presentation of Seven Closed Head Trauma Cases

Paul R. Kennedy

Abstract: A study was done on seven closed head trauma patients to determine the most common visual and non visual complications present following the injuries. The patients had a variety of etiologies and therefore had different presentations depending on the area of the brain affected and the extent of the damage that was done.

Closed head trauma patients present with a number of physical, cognitive, speech and vision problems following injury. In this study, seven closed head trauma patients were given a primary care optometric exam and were evaluated for some of the most common visual and non-visual complications. Although the seven patients had different forms of trauma; they all had received some form of closed head injury within the last year. Four of the patients suffered cerebrovascular accidents and the other three had some form of blunt trauma.

The visual areas that were evaluated included: central VA, convergence, accommodation, visual fields, visual neglect, oculomotor ability, color vision, blink rate, strabismus and ONH pallor. The non-visual data was gathered through case history and records from other health care professionals. The non-visual areas included: speech, motor/mobility and memory.

As seen in tables 1a and 1b, the most common visual complications were VF defects, convergence insufficiency, accommodative insufficiency and poor oculomotor skills (seen in 6 out of 7 cases). The most common visual field defect present was the homonymous hemianopsia (4 out of 7 patients). Other field defects that were noted were a complete constriction down to 10°, and one inferior altitudinal defect with loss on the right side superiorly ou. Poor oculomotor skills consisted of problems with pursuits and saccadic eye movements (jerky movements with under/overshooting). Accommodative insufficiency showed up as a need for a near add stronger than expected for the patients age.

Central visual acuity (20/25 or better) and color vision (>7/11 with PIC plates) was spared in four out of seven patients. Visual neglect was seen in 4/7 patients, and decreased blink rate and ONH pallor were only noted in 2 patients.

Table 1a

pat #	field defect	accommodative insufficiency	convergence insufficiency	oculomotor dysfunction
1	complete loss OD constricted field OS (10°)	+	+	+
2	inferior alt. defect OU	+	+	+
3	right homonymous hemi.	+	+	+
4	left homonymous hemi.	+	+	+
5	right homonymous hemi.	+	+	+
6	right homonymous hemi.	(-)	(-)	+
7	normal	+	+	(-)
total	**6/7**	**6/7**	**6/7**	**6/7**

Table 1b

pat #	VF neglect	↓ blink rt.	central VA loss	ONH pallor	strabismus	color vision loss
1	+	+	+	+	(-)	+
2	(-)	(-)	+	+	(-)	+
3	+	(-)	+	(-)	exotropia	(-)
4	+	(-)	(-)	(-)	exotropia	(-)
5	+	(-)	(-)	(-)	(-)	+
6	(-)	+	(-)	(-)	(-)	(-)
7	(-)	(-)	(-)	(-)	exotropia	(-)
total	**4/7**	**2/7**	**3/7**	**2/7**	**3/7**	3/7

Non-visual complications are shown in table 2. Three of the seven patients presented with significant motor dysfunctions. All three of these patients had hemiparesis on the side of the body opposite to the brain injury.

Some form of either receptive and/or expressive aphasia was present in four out of seven cases. Five out of the seven cases had memory loss to some extent. These two areas (speech and memory) were not specifically tested for, but were determined through case history and record review of the patients.

Table 2

pat #	motor dysfunctions	speech problems	memory loss
1	shuffling gait / left hemiparesis	+	+
2	(-)	+	+
3	(-)	+	+
4	left hemiparesis	(-)	(-)
5	(-)	(-)	+
6	right hemiparesis	+	+
7	(-)	(-)	(-)
total	**3/7**	**4/7**	**5/7**

This data supports previous studies showing that there are a wide variety of presentations following closed head trauma, including several visual complications. The presentation of complications depends on the area and extent of the damage that is done to the brain. Optometrists should be aware of these visual and non-visual complications and make sure that they are effectively managed.