Article

A Clinician's View of the Care of the Patient with Brain Injury, Related Eye and Vision Problems

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INTRODUCTION

My practice has always had a vision therapy base of patients with binocular and/or accommodative and/or visual perceptual deficits. Patients with stroke or head injury presented with symptoms, signs, and/or exam findings that seemed perplexing and difficult. That made me realize that I needed to learn more about the care of patients with brain injury. I listened to lectures by, and had conversations with, those I consider my mentors, Bill Padula, OD, Vince Vicci, OD, and John Thomas, OD. Those lectures and conversations, along with interaction with various colleagues in the Neuro-Optometric Rehabilitation Association and study toward NORA Clinical Certification Level I and II, broadened the base of my knowledge and increased my comfort level to work with patients suffering from neurological insult. I read and/or re-read textbooks relevant to the field. My favorites are listed at the end of this article. This article is a broad overview of my clinical experience in the field, rules of thumb, clinical impressions, clinical gems, observations, and to tell you what works for me. This is what I do!

I have learned to see brain injury-related vision problems as a continuum of difficulties ranging from specific focal brain damage (more typical in stroke, but certainly present in some traumatically brain injured patients) to more diffuse brain damage (more typical in the traumatically brain injured, but apparent in those who have had multiple past strokes). John Thomas, OD, taught me that following a traumatic brain injury (even mild brain injury) there is a cascade of degenerative neurobiochemical events that results in delayed and progressive, loss of neuro function. This secondary injury can cause symptoms and signs of Post-Trauma Vision Syndrome (timing disturbances between ambient and focal visual symptoms) occurring so many months later that the symptoms and signs may not be recognized by either the patient or by their health care practitioners as attributable to the initial insult. Dr. Thomas has noted that the neurobiochemical event causes cell membrane permeability changes, dumping out potassium, and calcium floods in. The calcium is toxic and activates protease enzymes that cause cytoskeletal disruption and collapse along with decoupling of the cerebral blood flow and cerebral glucose metabolism, further precipitating a spectrum of excitotoxic changes, which further damages the neurons with free radical release and further cell damage. Patients seek care for Post-Trauma Vision Syndrome symptoms and signs, that are occurring and often exacerbating long after the injury.

DIPLOPIA

Diplopia is particularly confusing to the patients when head injury-related cognitive issues do not allow them to recognize that their inability to function at activities of daily living, balance issues, reading ability, and

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their sense of well-being is affected by the double vision.

Many head injury patients do not express double vision as a specific symptom, but rather complain about such issues as being unable to concentrate when reading, reaching for and missing objects set before them (repeatedly knocking over a glass of water for example), and dizziness.

It is best not to automatically think of vestibular issues with a complaint of dizziness, or to think of injury-induced perceptual issues when a head injury patient has a complaint of difficulty comprehending reading materials, or to assume fine motor control deficits when a patient can not accurately grasp at objects. Do not assume that there is not a binocular dysfunction in a head injury patient who does not complain of double vision.

A patient with head injury was referred to me after the referring physician and the patient's family noted a left eye ptosis that became apparent soon after the head injury. During acuity testing, I handed the patient an occluder to cover his right eye as I lifted the left lid to allow the patient to read the eye chart. Simultaneously, the patient started to move the right eye occluder off center a bit, and as I let go of the ptotic left lid to recenter the occluder before the right eye, I noted the left lid had stayed open for a moment by itself. When I removed the occluder from the patient's right eye the ptosis recurred, but when I occluded the right eye, lifted up the left lid, and then let go of the lid, it momentarily stayed open. With encouragement and with the right eye occluded, I found that there really was no left eye ptosis. The patient had learned to habitually close the left eye to block the double vision of what was a hypertropic left eye. After using a prism bar to neutralize the vertical diplopia, and then encouraging the patient to keep both eyes open, the "ptosis" resolved.

Another patient claimed her head injury related diplopia had virtually resolved in recent weeks, except for some intermittent episodes of diplopia. She presented with a subtle off-center head position. She had made a subconscious and now habitual adaptation to her head injury-induced paretic extraocular muscle. It is very important for the clinician to observe the patient's presenting head position for an even slightly off-center posture. Assume it is masking a diplopia, until proved otherwise. A cover test was done with the head in the adapted position was ortho. By moving the patient's head to a neutral straight ahead position, the diplopia reappeared, and cover testing confirmed the now more obvious low angle paretic muscle.

Almost every patient seen with an obvious diplopia has been instructed by his or her neurologist or ophthalmologist to patch the "offending" eye. This makes the patient happy because the diplopia is resolved. Unfortunately this practice does embed the strabismus, and in my experience, regardless of conventional medical wisdom, many stroke/head injury-related paretic extraocular muscles can gain a wider range of motion, and often achieve resolution of the binocular dysfunction through alternating patching and vision therapy. Many patients have been told by their neurologist or ophthalmologist to ignore an eye muscle problem because it will either resolve or not on its own within a given length of time. It is as if brain plasticity is reserved as working only for the nonocular issues and that the ocular system is functioning on some other neurophysiological system.

Even some esotropic head injury patients, with their temporal range of motion apparently stuck at midline, have been able with therapy to gain increased motility in the affected eye to an amount beyond what conventional wisdom would allow.

There is a phenomenon I have noted in some patients with TBI/CVA-related diplopia, in which by just measuring the angle of the strabismus with a prism bar and simultaneously having the patient be consciously aware of the diplopia resolution through the prism, that the diplopia soon after spontaneously resolves or the angle of strabismus decreases markedly. It is as if stimulating the binocular reflex, even briefly, creates the change. Because of this, I rarely immediately Rx ground in prism until a reasonable (1–2 months) trial with fresnel prisms has shown the angle of deviation to be steady.

It is important to prescribe fresnel prism broken up between the two eyes, to allow the fresnel-induced reduction in contrast to be distributed evenly between both eyes. For example, if an esotropia-related diplopia is well

compensated with 10° of base out prism, it may seem simple and more cost effective to Rx a single 10°, base out fresnel prism. However, the patient will often complain of "blur" in the eye with the prism. Two 5° base out prisms distribute the reduced contrast, which reduces patient complaints, and the contrast of each individual eye is, indeed, better through a 5° fresnel than through a 10° fresnel. The use of a "split-prism" Rx allows the freedom to subsequently reduce, or rarely increase, the amount of prism more easily to fine tune the Rx as the patients diplopia changes. A trial of 2 weeks with any given prism power is indicated to see how their eyes adapt. After the patient consistently responds well to fresnel prism, a ground-in prism with antireflective coating is prescribed. Note that the angle of the paresis as measured at distance may be very different than at near, and separate distance glasses and reading glasses with different amounts of prism for each distance may be needed.

When appropriate, once a ground prism Rx has consistently created fusion, vision therapy is started with the goal of improving binocular ranges of fusion and reducing dependency on prism. After VT, a patient may once again begin to complain of diplopia. Never assume that a renewed complaint of diplopia implies a worsening of the condition. It often just means the strabismic angle is decreasing. Then, instead of having the eyeglass Rx re-ground, I prescribe small amounts of fresnel over their current glasses with a prism base opposite to that in the lenses. This neutralizes the prism in the glasses sequentially until a reasonable endpoint or plateau is reached, at which time the new ground in reduced prism power Rx is prescribed.

Do not be disheartened if some of this population of patients never respond as expected to the prisms you Rx. A prism bar may neutralize the diplopia, but when you Rx the initial fresnel, the patient still complains of double vision, and sometimes despite remeasuring, fine tuning, and changing prism power, the patient continues not to fuse. It seems that some neuro-related diplopias are caused by destruction of brain function in that part of the brain responsible for the binocular vision reflex. This "horror fusionalis," when it occurs, is difficult or impossible to resolve and requires occlusion. Specific spot occlusion works best with an occlusion foil of appropriate density placed over the patient's pupil area. This allows maintenance of peripheral/ambient vision of the offending eye, and, therefore, feels more comfortable to the patient than a totally occluded lens. In addition, by using graded occlusion foils, I can determine the least opaque/most transparent foil that eliminates the diplopia. This also increases adaptation to spot occlusion because it feels more natural, and the cosmetic appearance of a more translucent/transparent occluder is more acceptable to most patients. The shape of the selective occlusion should be adapted to the patient's binocular problem. A patient with a variable angle esotropia, depending on direction of gaze, may wind up with horizontal strip of occlusion foil along the axis of the range of motion in which the patient complains of diplopia.

Other procedures used in testing neuro patients for binocular deficits include determining a convergence near point "discomfort break point" which often occurs well before the patient actually notes diplopia during a push up convergence test. Patients with TBI-related convergence insufficiency often appear "visually defensive" to the near approach of a target, and pull their heads back and feel eyestrain as the target approaches, often well before diplopia or a break-point is noted. These visually defensive patients are more difficult to treat for convergence insufficiency. Some of them may not complain of diplopia, even when you notice the break in fusion, but when the test is performed with a pocket flashlight and with a red lens before one eye, they notice the diplopia occurring often within the range of their visual-defensiveness. Repeating the testing through low plus powered lenses (+0.75 OU) may decrease the visually defensive response, increase the patients convergence and comfort during the test, thereby indicating an accommodative component requiring a "plus" near vision eyeglass Rx. Low powered base in prism (2° base out to 3° base out) often provides additional relief of symptoms.

Patients with a recent head injury and a cosmetically large angle vertical or horizontal paresis may not complain of diplopia. This often leads to the erroneous assumption that there had been a premorbid strabismus to

which the patient had adapted by suppression. The lack of double vision is often because the angle of misalignment is so large that the patient can concentrate on the image from the nonstrabismic eye while ignoring, but not suppressing the diplopic image that is located way off center, far enough peripherally to be ignored. Although they do not complain of diplopia, they may have behavioral symptoms of the confusion, balance issues, or ambulatory problems because of ambient visual confusion induced by the ambient diplopic image.

AMBIENT VISION DYSFUNCTION

Patients with ambient vision dysfunction cannot attend well visually. They find it difficult to visually sort out things in a busy visual environment, be it objects on their desk, or having confusion and suffering anxiety in crowds, as at the mall. Some note apparent movement of stable objects. They are visually distracted patients who cannot concentrate visually and may complain that their vision does not seem clear, although their visual acuity is 20/20.

Clinically screen for ambient vision dysfunction by having the patient binocularly view a block of lines on the eye chart, while attending to the smallest readable line. Then wiggle your fingers bilaterally and rapidly in the patient's peripheral field, and ask the patient to be aware of any blurring of the chart or difficulty attending to the chart. Patients without ambient vision dysfunction do not have a problem with this test. Separate your fingers (index and middle) in a "V" pattern, then into an inverted "V" and place them adjacent to either side of the bridge of the patient's nose. This digital binasal occlusion screening will often result in the patient's awareness of either more "comfortable" and/or clearer eyesight.

A high-quality multi-layered antireflection coating will decrease ophthalmic lens reflections and glare and make the patient more comfortable. Tints of various absorption often "soften" the vision of many of these patients and make them more visually comfortable. A 25% brown or gray tint works best, although some prefer more subtle (10%) tints. Occasional patients prefer darker tints or other colors, most often shades of blue. Always prescribe binasal occlusion for ambient vision dysfunction. Binasal occlusion allows the patient to have reduced ambient input. Explain to the patient that the nasal occluder before the right eye blocks the ambient field to the patients left, and conversely the left eye nasal occluder blocks the ambient field to the patient's right. This results in less visual input to the side, without actually blocking side vision, as bitemporal occluders will do.

The patient with ambient vision dysfunction invariably responds well to binasal occlusion, noting less visual distraction, and also less anxiety in a busy visual environment, and often remarking that their vision seems more "solid." When a patient does not have a distance refractive error, Rx plano eyeglass lenses with antireflection coating, and then apply binasal occlusion to the lenses. For expediency when examining an in-patient, use 3M "Transpore" surgical tape. It is opaque with some translucency and adheres well to ophthalmic lenses, while being able to be easily removed without leaving permanent marks on the patient's lenses. However, for all other patients use Fresnel Prism Company occlusion foils. They are graded by levels of transparency relative to acuity from almost clear (20/30) to opaqueness at a level allowing just light perception, and are much more cosmetically acceptable. Most patients do well with binasal occluders that are placed on an approximate 30° angle from vertical, so that the wider portion is above the nasal pupil margin, with the foil narrowing down to just at the nasal portion of pupil margin on its way down to the lower inner portion of the lens. Occasional patients are more comfortable with somewhat narrower binasal occlusion strips, or strips at a different angle, but it's always easier to remove a wider strip and cut it back to narrow its width than to have to replace it with a new one and reposition the binasal strips. After placement of the binasals on the patient's eyeglasses, place the eyewear face down on a photocopier and make a copy. The resulting copy gives an accurate representation of the angle and width of the occluders on the patient's lenses. As the patients ambient vision symptoms resolved, I used to narrow the strips by a millimeter or two. A better technique, which allows more accurate sequential gradation when adjusting the binasals relative to the patients resolving binasal

dysfunction, is to keep the width of the binasal strips at their initial width, but gradually increase the transparency of the occlusion foils. Patients appreciate the increasing cosmetic appearance of the increasing transparency as their ambient dysfunction resolves, and this procedure gradually and scientifically reduces the "strength" of the binasal occlusion.

VISUAL FIELD LOSS

A quick, gross screening for hemianopic field loss is a confrontation test using simultaneous double stimulation. Although hemianopic loss is most often found in stroke patients, many head injury patients have more focal injuries resulting in hemianopic field loss. Never perform a gross confrontation field on a patient without having had enough interaction with the patient to discern their apparent cognitive level. Patients with poor attention or cognitive issues will respond with false-positive or false-negative responses. A "normal" gross confrontation field does not definitively rule out a field loss. Many patients with normal confrontation fields show obvious field deficits during Humphrey Sita-Fast Threshold Testing.

If there are cognitive issues, the patient is screened with a nonthreshold Humphrey central 40 screening field, and if a patient can handle that easier test well, I perform a Humphrey Sita Fast 24-2 as the baseline of the patient's visual field. A carefully performed hand-held perimeter works well for assessing constriction in the field beyond the central 24°.

Patients with hemianopic or peripheral field loss, which have a negative impact on their activities of daily living or create safety issues, need special care. At a minimum, when treating a patient with hemianopsia or field constriction, change their bifocals or progressive lenses to single vision. The optical blurring from the "add" creates one more section of limited vision in the patients already affected field when the patient is ambulating. Furthermore, patients with field loss do best for reading when using the wider span of a single vision reading lens. Patients with hemi field loss often read better with small amounts of yoked prism with the base toward the field loss. A good starting point is 5°, which is placed in a trial frame and then initially Rx with fresnels, but warning the patient to expect a possible slight decrease in contrast. If the patient continues to be able to scan across the page well, then Rx the prism ground into their ophthalmic lens prescription.

Many field loss patients do well reading with a reading guide made out of a piece of black plastic or cardboard with a horizontal slot cut out. For improving safety issues when ambulating, you may prescribe special eye wear manufactured as "Visual Field Awareness System" by the Gottleib Vision Group in Stone Mountain, Georgia, or the Inwave Field Expanding System, Manufactured by Chadwick Optical in White River Junction, Vermont. The Gottleib "prism button" type field loss lens gives clear vision with a wonderful patient acceptance, and because it has a distinct edge, it is easy for the patient to find when scanning the peripheral objects in their field.

The Inwave system is viewed as more cosmetically acceptable by some patients but because the linear demarcation of the field loss, prism area is more subtle; it is somewhat more difficult for some patients to find when scanning for peripheral objects in their field.

A rule of thumb for successful placement of the field loss portion of the lens is to place it monocularly at the lateral pupil margin in normal room lighting, rather than using more complex systems of field loss lens placement, which are noted in the literature and/or used by other practitioners. To minimize reflections that may be induced by these thicker prism lenses, I recommend antireflection coating and the use of "Transitions" when available to make the eyewear more useful to the patient.

In addition, when treating a patient with field loss lenses, appropriate training to scan properly to use the device is necessary. Some trauma patients have injury-related neck range of motion issues. These patients have a somewhat lower level of success with field loss eyewear, and occupational therapy cervical-neck range of motion testing and treatment is additionally indicated.

POSTURAL AND BALANCE ISSUES

Patients with a visual midline shift respond well to high-power yoked prism, usually with the prism base toward the patients neglected hemi field and/or opposite to the direction of the midline shift (*i.e.,* if midline shift is

to the patients left, use base right yoked prism, if the patients midline shift is rearward (extension), use prism base up to bring the patient more forward toward vertical; or in flexion (forward midline shift), use base down yoked prism. Bernell Rotatable prism glasses are excellent for testing purposes. Useful powers are 2, 5, 8, 10, 12, 15, and 20 prism diopters. Starting power to test with is based on how much of a midline shift the patient seems to have. If the patient is almost falling to one side unless held or supported by someone, start with a 20 prism diopter yoked prism lens; if a patient barely drifts toward the right or left when ambulating, start with a 5 prism diopter yoked prism lens.

Prescribe yoked prism glasses during active ambulatory vision therapy or during active ambulatory occupational therapy, on an approximate 10 minute on/10 minute off schedule, which prevents prism adaptation and allows for "carry over" of the therapeutic effect of the prism when the prisms are removed. Unless the patient has a large refractive error, it is not necessary for the patient to wear their eyeglasses under the prism, as long as the patient can attend visually on a target about 15 feet away. A patient who cannot attend well visually and maintain cognitive attention at least 15 feet away will not do well with yoked prism lenses prescribed for visual midline shift.

As the patient learns to balance and ambulate with less midline shift, the power of the yoked prism glasses should be lowered accordingly. Occasional patients do not have "carry over" when the yoked prisms are removed, but also do not "adapt" to the yoked prism when worn constantly. The prism remains continuously effective, even when worn fulltime. For this set of patients, prescribing yoked prism ground into their eyeglasses works well unless the power is too high to grind in. In that case, use the maximum ground in power available, with Fresnel Prism added as indicated, along with antireflection coating.

Patients with balance and postural issues often who complain of dizziness and vestibular dysfunction need to be evaluated. I use a series of seven vestibular tests and three vestibular ocular reflex tests to investigate vestibular dysfunction. It is not necessary to use all 10 tests on a given patient. I merely perform enough of the series to make me comfortable that the patient probably has vestibular dysfunction. Depending on your comfort level and on the apparent degree of the vestibular dysfunction, the patient should be treated by you with visual-vestibular therapies and/or referred to a physical therapist or occupational therapist skilled in vestibular dysfunction and/or to an ENT physician skilled in vestibular dysfunction and/or a neuro-otologist. Most tests that I use may be found in the book, *Vestibular Rehabilitation,* edited by Susan Herdman, PhD, PT.

EYELID PARESIS

Head trauma and/or direct trauma to the lids and or periorbital areas may result in blepharoparesis (a lid that won't close), or can cause ptosis. Many ptosis patients respond well to quick stroke massage of the eyelid. The massage is done with a finger, using a brisk moderate stroking of the affected lid in a redial fan-shaped manner. Sometimes a heated or cooled finger, (hold your finger under running water, temperature as needed), will increase sensory stimulation to the nerve pathway in the lids. This massage should be done three times per day for at least a month for a therapeutic effect to be noted. Encouraging the patient to use the forehead frontalis muscles, will help keep the lid up in some cases. Sometmes encouraging forced closure of the ptotic lid, followed by relaxation of the lid will often result in a rebound reduction in the ptosis. When needed, Transpore tape can be used to gently lift the lid. Use an alcohol prep pad on the forehead above the ptotic lid and a squeezed out damp alcohol prep pad (while the lid is closed) to remove oils from the affected lid. Apply the tape from the lash margin to the forehead, leaving the tape just taut enough to elevate the lid for the patient to see through the eye, but loose enough so that some blinking can occur to keep the eye moist. Supplemental use of artificial tear drops while the eye is taped open is important. Remember that some patients present with a monocular pseudo-ptosis lid closure to avoid diplopia from a traumatic E.O.M. paresis. Although rare, be sure to rule out this pseudo-ptosis.

Patients who have blepharoparesis and cannot close the lid, may also respond to quick stroke massage and by exercising the lid with

forced opening of the lid, followed by relaxation, which may result in some rebound closing of the lid. In addition, Med Dev lid weights are available to pull the lid down. The lid weights come in a fitting set of graded weights with an adhesive tape, which keeps it on the lid. These were actually designed as a test to determine the weight of a gold lid implant used by occuplastic surgeons. Use the weights to treat blepharoparesis noninvasively. If, over time, the blepharoparesis seems to be permanent and/or the patient wants a more permanent, hassle free approach, refer the patient for oculoplastic gold weight implantation.

PHOTOPHOBIA

Following head trauma, rod and cone mechanisms may be disinhibited, creating an imbalance of the rod/cone systems, usually with greater suppression of the rod-mediated system. This causes photophobia and a possible reduction in dark adaptation. The neurotoxic cascade, which occurs after brain injury, is the probable etiology of this phenomenon. Although spontaneous resolution of the photophobia may occur, resolution can often be hastened by photophobia desensitization/habituation training. Use bright lights shined into the eyes, starting with illumination just bright enough to annoy the patient, and then increasing the intensity over time. A handheld transilluminator with a rheostat control works well for this procedure.

Corning CPF lenses are specially designed glass photo chromic filters. They have specific wavelength absorptions thay cause the lenses to present in specific tints from yellow to orange to brown and reddish. To various degrees, depending on the CPF lens prescribed, these lenses successfully increase subjective contrast and sometimes increase a measurable amount of contrast sensitivity. They will effectively reduce bright light and decrease photophobic discomfort.

The darker orange and reddish tints should not be used for night driving because they are too dark and may during daytime wear, alter a patient's ability to note the color of traffic lights. You should verify with the patient that for daytime use they can still easily recognize the colors of traffic signals while driving. For testing purposes, a complete paired set of the CPF lenses can be assembled in trial rings, so that patients may try them on and test them in a trial frame with their refractive Rx in place.

About 5 years ago I met Mr. Tony Totsuka, an optical scientist who had developed a manually adjustable sun filter eyeglass system called "Sundials." The filters are in the form of a specially designed Polaroid material that does not create stress patterns when you look through "safety-glass" windows or car windshields. Sundials come in a variety of wavelength absorptions with a wider color range than CPF lenses, from yellow to orangish and also gray, blue, vermillion, and lavender. Sundials come in two frame styles and side shields are available. Mr. Totsuka, asked me to determine clinically which of my patients respond best to specific tints. I came up with a flow chart for various "kits" of selected CPF filters. The dark gray cartridge, when combined with the gray or brown carrier lens is darker than any other commercially available lens tint, and is manually adjustable by the patient in consideration of their level of photophobia. I have never had a photophobic patient who was not helped by the darkest Sundial lenses. I also use the prescribed Sundials therapeutically to treat photophobia by having the patient use them to habituate their eyes to gradually increasing levels of illumination. The patient goes out of doors on a bright day, or indoors if necessary, and gradually dials the lens to let more light in until it becomes somewhat uncomfortable. They then hold it at that level for a few minutes, and then rotate the filter back to a better comfort level. For most photophobic patients such repetitive treatments gradually increase the level of illumination that the patient can tolerate.

HOSPITAL CARE EQUIPMENT

Many rehabilitation hospitals do not have a staff consulting optometric physician who is skilled in neuro-optometric rehabilitation, and this is a good opportunity to help patients who are at lower level than those you see in your office. However, if you do not have the time to see patients on a "stat" basis, after work or on your days off, or cannot complete a routine consult within the usual 72-hour period required, do not apply to be on staff.

To do your job well at the hospital, it is important to have a traveling kit of enough equipment to cover the range of care of hospital patients you see. The following is a list of a basic kit of portable hospital equipment you should have.

1. Trail frame, trial lenses
2. Ophthalmoscope, retina scope, transilluminator
3. Indirect ophthalmoscope and dilating drops
4. Lensometer
5. Prism bars (vertical and horizontal)
6. Eye charts for distance and near, a standard Snellen chart with letters and a "low vision" chart with numbers. Many aphasic patients can recognize numbers although they can not recognize letters. The "Broken Wheel" acuity test and the "Leg" symbols or "House-Apple-Umbrella" test, are useful for patients who can not handle either letter or number eye charts.
7. Flurescein dye and a black light
8. Schirmer tear strips
9. Tonopen
10. Amsler grid test
11. Hand-held perimeter
12. Transpore tape for making temporary trial binasal occluders and for taping up a ptosis
13. A set of rotatable yoked prism glasses
14. Hand-held occluders, a pinhole occluder and "pirate patch" occluders
15. Copy Forms Test
16. Motor-Free Visual Perception Test
17. A rolling luggage cart to transport the equipment

MISCELLANEOUS CLINICAL THOUGHTS

When working with head trauma, be aware that head injuries are often associated with emotional as well as cognitive issues. Patients are usually aware that they are not functioning very well, and have social/marital issues, and difficulty working at their occupation. They are often emotionally labile and/or depressed. They often do not understand your explanations about diagnosis or treatment. They may be quick to anger and quick to cry. Directions are best reinforced in writing. Make sure you "inform before you perform," and try to have a family member or significant other present at all case presentations and consultations. Head injury patients are prone to forget about appointments and "no-show" more than most of patients.

Working with patients who have vision problems caused by head trauma, is, for me, the most rewarding aspect of my practice. Yes, it takes a high level of patience, specialized knowledge, and lots of practice experience to do the best for the head-injured population, but it is worth the effort. I feel truly blessed to have been given the opportunity to be involved in neuro-optometric rehabilitation.

APPENDIX: PRISM GLASSES INFORMATION: FOR THE PATIENT

Prism eyeglasses are prescribed for double vision, realigning the visual motor system, improving visually related balance of postural problems, or for nystagmus.

Patients receiving prism for double vision or eye coordination problems should realize that eye muscle alignment usually varies with angle of viewing and may vary at different times of day. In addition, eye alignment often changes with the passage of time as weeks and/or months go by. Furthermore, the amount of prism needed for distance seeing may be different from the prism power needed for close-up reading.

Most patients do well with prism, but an occasional patient finds it difficult to adapt to prism lenses. Rarely there will not be any prism glasses that will be fully satisfactory.

Some eye conditions treated with prism require more than one pair for different tasks, or for different times of the day, and some patients adjust to prism better than others.

Some patients who need prism glasses require a number of changes in prism prescription to solve their visual problems as their eyes re-adjust.

Patients with nystagmus often have a null point at a position, which is at an angle too great to be practically ground into glasses; furthermore, it is difficult to adjust to high amounts of prism if prescribed all at once and so a lower power will initially be prescribed.

None of this can be predicted in advance, so patients with prism should be prepared for additional fees for office visits, and for prism

lens changes, as changes in prism prescription become necessary. Rarely a patient's eye alignment changes radically before the prism glasses are dispensed and less frequently there is spontaneous resolution of the double vision. There is no refund for ground-in prism glasses manufactured prior to such a change. There is also no refund for a temporary prism, which has been cut and/or applied to existing eyewear.

At first, your vision may feel strange with new prism glasses. This is normal. It takes most patient at least 2 weeks of constant prism wear for the eyes to adapt to the prism glasses. Try to wear them as much as possible until we see you again. You will be re-examined in about 2 weeks, at which time, changes in the power of the prism (if indicated) may be made.

Please remember that eye alignment problems change at different rates and patient's response to prism varies. That is why we cannot predict how well you will do, or how many office visits you will need, or how many prescription changes you will require.

If temporary press-on prisms have been prescribed, you can expect a reduction in visual clarity when viewing through the prism. This is normal because temporary prisms are composed of little ridges, and small air bubbles develop between the lens and prism. To clean the temporary prism glasses, dip your eyewear in slightly soapy warm water (use dish soap), then rinse with clear warm water, and pat dry with a soft lint-free cloth.

Once temporary press-on prisms have been shown to be effective, permanent, optically clear ground-in prism may be prescribed. Some patients, who have had resolution of their double vision with temporary prisms, still have some residual double vision with ground-in prism. This cannot be predicted in advance, and is related to the difference in thickness between temporary prism and ground-in prism. In those cases, press-on prisms are prescribed to be applied over the ground-in prism to compensate for any residual double vision.

Glare-Reducing (and/or Contrast Improving) Lens Test: CPF or Sundials

It is important that you understand that most patients notice these lenses reduce glare and/or increase contrast and/or make things seem clearer and/or give a sense of better depth perception, but may not necessarily improve eye chart vision or depth perception testing.

The tint prescribed for you will be more effective under glare situations similar to those you were tested for and may not be as effective for brighter or dimmer light exposure. Some patients require different tint densities for specific visual needs and, therefore, may require more than one pair of glare-reducing glasses.

In addition, some of these lenses have a red–orange, orange, or yellowish tint, which may cause some colors to appear different through them (requiring caution when using the darker tints to view traffic lights). Also, the darker tints may be too dark for night seeing.

The following questions will help you decide if these lenses are for you:

Indoors with the Lenses

My eyes feel more comfortable (less eyestrain).	Yes	No
My eyes feel less sensitive to light.	Yes	No
My vision seems clearer.	Yes	No
My depth perception seems better.	Yes	No
My overall impression is that these lenses are helpful to my indoor vision.	Yes	No

Tint Chosen Indoors: _____

Outdoors with the Lenses

My eyes feel more comfortable (less eyestrain).	Yes	No
My eyes feel less sensitive to light.	Yes	No
My vision seems clearer.	Yes	No
My depth perception seems better.	Yes	No
My overall impression is that these lenses are helpful to my outdoor vision.	Yes	No

Tint Chosen Outdoors: _____

RECOMMENDATION FOR THE USE OF SUNDIALS

The following four sets of Sundials color combination trial kits are recommended (depending on the patient's visual problems).

The Doctor first decides if the patient's vision is related to either:

Patient Visual Problem

- Glare-photophobia Start with trial kit #1
- Contrast sensitivity Start with trial kit #2
- Non-specific, rather vague problems associated with light exposure indoors and outdoors Start with trial kit #3
- Computer screen difficulty Start with trial kit #4

Sundials Combination

Trial Kit Number	Base Lens Color	Color Cartridge
1	Gray	Gray, Brown, Extra Dark Grey
	Brown	Brown
	Dark Green	Gray
2	Vermilion	SD550
	Yellow	SD450, SD550
	Orange	SD450, SD550
3-Indoor	Vermilion	Yellow, Lavender
	Orange	Yellow
3-Outdoor	Gray	Gray, Yellow, Vermilion
	Brown	Gray, Yellow, Lavender
	Dark Green	Yellow
4	Vermilion	Yellow, Blue
	Yellow	Vermilion, Yellow
	Orange	Yellow

If the above suggested combinations are not solving your patient's problem, feel free to custom design the combination of various colors, and color cartridge which works best for your patient.

VESTIBULAR SCREENING TESTS

1. Fukada "Stepping in-place" Test
   a. The patient stands with arms out straight ahead of them at a 90° angle to body.
   b. Patient steps in place 50 steps.
   c. Compare the test done eyes open, to the test done with eyes closed, and observe and measure movement forward, and/or degrees and direction of turning.
   d. Normal subjects move forward less than 20 inches and turned less than 30° at end of 50 steps.
   e. Some patients with unilateral vestibular loss, rotate slowly toward the side of the lesion, and some patients with bilateral vestibular loss may shift their weight forward or backward.
2. Romberg Test
   a. Standard Romberg Test
      1. Arms across chest with feet together
      2. Test ability to maintain position for 30 seconds
      3. Compare eyes open to eyes closed
   b. Tandem (or "Sharpened") Romberg
      Test done same as above, but with heel to toe stance
3. Tandem Walk Test
   a. Arms across chest
   b. Heel to toe tandem walking for 10 steps
   c. Compare eyes open to eyes closed
4. Stand on One Leg Test
   a. Arms at normal stance
   b. Stand on one leg without bracing one leg against the other.
   c. Compare eyes open/closed
5. Gait Analysis
   a. Walk at normal speed, then walk at slow speed, then again walk at quick speed, etc. (Patients with vestibular dysfunction have instability when changing speed).
   b. Watch for rotation through trunk and neck.
   c. Watch for excessive visual fixation to maintain balance.
   d. Watch for stiff robot-like gait or loss of balance.
   e. Watch for veering to right or left.
   f. Ask about dizziness, or other symptoms such as oscillopsia.
   g. Patient can be asked to turn head repeatedly while walking to perturb balance.
6. Singleton Test
   Patient walks quickly and is to pivot suddenly to right or left on the examiner's command. Watch for signs or symptoms as in gait analysis.
7. Stability Limits Test
   a. Stand normally with feet planted.
   b. Normal subjects sway no more than 40° back or 8° forward without losing balance or taking a step.
   c. Compare eyes open to eye closed. If a patient has vestibular dysfunction, when he performs the test with his eyes closed, the loss of visual input will result in marked increase in sways or falls.
   d. A variation of this test is to have the patient stand on a compliant foam pad that decreases the ability to use somatosensory clues for orientation.

VESTIBULAR OCULAR REFLEX TEST

1. Head Shake Acuity Test
   a. Measure acuity with head still.
   b. Shake head side to side as when saying "no," at rate of about 1½ to 2 cycles per second, with an amplitude of about 20°.
   c. While head is moving remeasure acuity. Normal subjects or subjects well adapted to a peripheral lesion will have no reduction in acuity. Poorly adapted patients acuity will deteriorate about 2 lines of vision.
2. Head Shake Ophthalmoscopy Test
   View disc of a dilated eye during a 2–3 cycle per second head shake from side to side as when saying "no."
   A stationary disc indicates a normal VOR.

3. Head Shaking Nystagmus Test
   a. Patient shakes head from side to side 2–3 cycles per second.
   b. In normal individuals, no "after nystagmus" is seen when the head stops.
   c. In patients with unilateral peripheral vestibular disease, "after nystagmus" is seen in the absence of visual fixation, (using Fresnel glasses), beating in the direction of the healthy ear.

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