Many optometrists think of a referral to a neuro-optometrist as a last resort or something that is suitable only for life-threatening conditions such as a suspected brain tumor. The reality is that most optometrists have patients in their practice who could benefit from a neuro-optometry referral. These patients might be athletes who have had a concussion, adults who have experienced whiplash in a car accident, elderly people with balance issues, or seemingly healthy children who are struggling in school.

I should know. I was in that last category. As a child, after a fall from the playground monkey bars, I struggled with reading and was considered to have a learning disability until a functional optometrist finally diagnosed me with significant eye tracking and teaming deficits at age 13. That experience, and the realization that many other kids may not be performing to their potentials, led me into a career as a concussion specialist and functional vision optometrist.

PRIMARY IMPORTANCE

More of the brain’s real estate is dedicated to vision, and to its integration into other senses, than to any other sensory modality. So it makes sense that vision is of primary importance in identifying brain injury and monitoring recovery from brain injury.

More than 50% of patients with traumatic brain injury
TBI) have eye tracking and ocular teaming difficulties. One study found that 90% of patients with TBI and 87% of those with cerebrovascular accident (CVA) had oculomotor dysfunction. Among military personal with blast-induced mild TBIs, visual dysfunctions were much more common than among individuals who hadn’t experienced a TBI (Table).

SCREENING FOR SYMPTOMS
Given what we are learning about the impact of TBI on visual processing, it is important that optometrists begin to test visual function more proactively. Although static or cycloplegic refraction is important, it doesn’t tell us how the eyes work as a team and focus together. For that, we need dynamic vision testing measures. I recommend adding a brief neuro-optometric screening to your comprehensive eye examinations, as well as asking patients to complete a symptom questionnaire.

In about 5 minutes, an optometrist can perform three tests that provide crucial information about visual function and how well the eyes work together.

Test No. 1: Near Point Convergence
Sitting across from the patient, slowly move your finger or a pencil toward the patient, aiming right between the eyes (Figure 1). The eyes should converge—nearly crossing—as the finger gets closer. If one or both eyes turn away and break convergence further than 7 inches from the face, refer to a neuro-optometrist.

Test No. 2: Pursuits
With your finger or a pencil, slowly trace a circle in the air roughly tracing the patient’s face. You don’t need to attract the gaze further out to the periphery. The eyes should follow the pointer all the way around. If the patient loses fixation more than two or three times around the circle or experiences symptoms (dizziness, blur, headache, or eye strain) from maintaining fixation, refer to a neuro-optometrist.

Test No. 3: Cover/Uncover Test
Ask the patient to look straight ahead at a distance target. Cover one eye for approximately 1 to 2 seconds while observing the uncovered eye for any shift in fixation, which would suggest strabismus. Continue this process with each eye, then repeat at a distance of 16 inches. If you see an eye shift, refer the patient to a neuro-optometrist.

Alternatively, a technician can perform pretesting that provides similar information. The EyeQ tests (RightEye) measure pursuits, saccades, and a number of other eye tracking features that can help assess brain function. The King-Devick test (King-Devick Technologies) can provide valuable insight into eye movement problems. These should be combined with either Randot stereo testing (multiple vendors) for depth perception and convergence or near-point convergence testing by the optometrist.

QUESTIONS, QUESTIONS
Ideally, I would like to see more practices administer the Brain Injury Vision Symptom Survey (BIVSS), which is available on the website of the Neuro-Optometric Rehabilitation Association (NORA) at bit.ly/BIVSScheck. This 28-item validated questionnaire can be given and scored by a staff member, so that it doesn’t take up much of the doctor’s time. A score of 31 or higher out of a possible 112 is considered predictive of brain injury and likewise should be considered grounds for referral to a neuro-optometrist.

For practices that aren’t ready or able to implement the full BIVSS questionnaire, I recommend asking at least these three questions as part of the history:
- Do you ever see double at distance or near?
- Do you have any trouble with balance?

People who might benefit from a referral to neuro-optometry may include athletes after a concussion, adults with whiplash after a car accident, elderly people with balance issues, or seemingly healthy children who are struggling in school.

More than 50% of patients with traumatic brain injury have eye tracking and ocular teaming difficulties.

Adding a brief neuro-optometric screening to the comprehensive eye examination and asking patients a few questions can help identify people who might benefit from a referral.
Do you have any trouble concentrating while reading? If the answer to any of these questions is yes, consider a referral.

**HOW TO REFER**

It is best to screen all patients because many people don’t even realize they or their child have experienced a TBI. Even if they are aware of the TBI, they often don’t associate problems with focus, concentration, or balance with vision, so they may never bring up these symptoms during an eye examination if not directly asked.

To establish resources for neuro-optometric referral, contact or meet with neuro-optometrists in your community. A number of organizations can help you find local doctors and other resources, including NORA, the College of Optometrists in Vision Development, the International Sports Vision Association, and the Optometric Extension Program Foundation (see *Neuro-Optometric Resources*).

If there are no reasonably nearby neuro-optometrists (in some states or rural areas, there might not be), consider attending a neuro-optometric conference, taking an online course, or visiting a neuro-optometric clinic to learn more about what you yourself can do to treat these patients.

A neuro-optometrist will often alter a patient’s prescription at the beginning of treatment and possibly again at the end, sending the patient back to his or her primary care optometrist to be fit with new lenses unless the lenses require unusual expertise. We typically see patients weekly for at least eight to 12 sessions of vision therapy, and perhaps as many as 30, depending on the condition. Tools used may include lens tints, prisms, occlusion filters, and therapeutic exercises. Neuro-optometric treatment should not disrupt annual visits with the primary care optometrist.

### TABLE. Ocular Motor Dysfunction Following Mild TBI

<table>
<thead>
<tr>
<th></th>
<th>% MTBI</th>
<th>% CONTROLS</th>
<th>P VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convergence insufficiency</td>
<td>55%</td>
<td>5%</td>
<td>.0012</td>
</tr>
<tr>
<td>Saccadic impairment</td>
<td>30%</td>
<td>0%</td>
<td>.0202</td>
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<tr>
<td>Pursuit impairment</td>
<td>60%</td>
<td>0%</td>
<td>.0001</td>
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<td>Vertical phoria</td>
<td>55%</td>
<td>5%</td>
<td>.0012</td>
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<tr>
<td>Horizontal phoria</td>
<td>45%</td>
<td>5%</td>
<td>.0084</td>
</tr>
<tr>
<td>Accommodative dysfunction</td>
<td>65%</td>
<td>15%</td>
<td>.0031</td>
</tr>
</tbody>
</table>

Abbreviation: MTBI, mild traumatic brain injury

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Figure 2. Dr. Polec (left) performs the visual midline shift test, wherein the clinician uses prismatic goggles while observing balance, posture, movement, and perceptual difficulties to best integrate vision with body.
NEURO-OPTOMETRIC TREATMENT AND REHABILITATION CAN BE LIFE-CHANGING FOR PATIENTS. WE TEACH PATIENTS HOW TO INTEGRATE MULTIPLE SENSORY SYSTEMS WITH VISION, THE BRAIN’S POWERHOUSE. THIS CAN ALLOW THEM TO REGAIN OR IMPROVE THEIR ABILITY TO WALK, DRIVE, READ, OR COPY FROM A CHALKBOARD, OR TO IMPROVE THEIR SPORTS PERFORMANCE (FIGURE 2). ADDITIONALLY, INTEREST IN EYE TRACKING AS A WAY TO DIAGNOSE AND FOLLOW CONCUSSION IS INCREASING, AND OPTOMETRISTS ARE ON THE FRONT END OF UNDERSTANDING THIS PROCESS. REFERRING PATIENTS WHO COULD BENEFIT IS AN OPPORTUNITY TO TRULY MAKE A DIFFERENCE IN THEIR LIVES. EVERY MODERN OPTOMETRIST SHOULD BE ABLE TO EVALUATE VISUAL PROCESSING AND TO REFER PATIENTS FOR MORE IN-DEPTH EVALUATION AND TREATMENT WHEN NEEDED.


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• Vision consultant for Sports Medicine Rehabilitation and Concussion Center (SPARCC), Tucson, Arizona
• Member, board of directors, Neuro-Optometric Rehabilitation Association
• info@vqlsr.com
• Financial disclosure: None

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NEURO-OPTOMETRIC RESOURCES

THE COLLEGE OF OPTOMETRISTS IN VISION DEVELOPMENT | www.covd.org
The College of Optometrists in Vision Development (COVD) is a nonprofit, international membership association of eye care professionals including optometrists, optometry students, and vision therapists. Established in 1971, COVD provides board certification for optometrists and vision therapists who are prepared to offer state-of-the-art services in behavioral and developmental vision care, vision therapy, and/or neuro-optometric rehabilitation.

The next annual meeting of the COVD will take place April 21-25, 2020, in Toronto.

THE INTERNATIONAL SPORTS VISION ASSOCIATION | www.sportsvision.pro
The International Sports Vision Association (ISVA) is an interdisciplinary group of professionals dedicated to advancing the field of vision training for athletes of all ages and levels to help them achieve peak athletic performance.

The next ISVA annual conference will be held February 6-8, 2020, in San Diego.

THE NEURO-OPTOMETRIC REHABILITATION ASSOCIATION | https://noravisionrehab.org
The Neuro-Optometric Rehabilitation Association International (NORA) is an interdisciplinary group of professionals dedicated to providing patients who have physical or cognitive disabilities as a result of an acquired brain injury with a complete ocular health evaluation and optimum visual rehabilitation education and services to improve their quality of life.

NORA’s 2019 annual conference will take place September 19-22, 2019, in Scottsdale, Arizona.

THE OPTOMETRIC EXTENSION PROGRAM FOUNDATION | www.oepf.org
The Optometric Extension Program (OEP) Foundation is an international organization dedicated to the advancement of the discipline of optometry through the gathering and dissemination of information on vision and the visual process.

OEP clinical curricula are offered throughout the year. Check the OEP Foundation’s website for details.