



Doctors of Optometry Efforts to Minimize and Prevent Traumatic Brain Injury

The AOA Sports and Performance Vision Committee (SPVC) works to promote the value of optometry in the team management of post-concussion syndrome and assisted in the writing of this HPI report.

In 2014, there were approximately 2.5 million Traumatic Brain Injury (TBI)-related emergency department visits in the U.S., including more than 812,000 among children.ⁱ Rates of TBI-related emergency department visits per 100,000 population were highest among older adults aged ≥ 75 years, young children aged 0-4 years, and individuals 15-24 years. The most common mechanisms of injury contributing to a TBI diagnosis in the emergency department included unintentional falls, being struck by or against an object, and motor vehicle crashes. These three principal mechanisms of injury accounted for 47.9%, 17.1%, and 13.2%, respectively, of all TBI-related emergency department visits.ⁱⁱ

Efforts to minimize and prevent TBIs are a shared goal among the public health and medical communities.

Impaired Vision as a Cause of TBI: Unintentional Falls

Impaired vision is an important and independent risk factor for unintentional falls, the primary cause of TBI among older individuals. By improving impaired vision through comprehensive eye examination and appropriate treatment, there is evidence of enhanced balance and reductions in unintentional falls.

Adequate visual depth perception and perceived distant-edge-contrast sensitivity, made worse by conditions that forced individuals to view test stimuli through the lower segments of their glasses, appear to be important considerations for maintaining balance and detecting and avoiding hazards of the environment.ⁱⁱⁱ Within the human neurological system, the vestibulo-ocular reflex (VOR) system helps to control balance and the perception of dizziness. For example, reduced visual inputs as observed in visual impairment or uncorrected refractive error may weaken the VOR and contribute to balance problems and dramatically increase the risk of unintentional falls. Common degenerative pathways or lower physical activity levels may also affect balance, particularly among those with visual impairment.^{iv}

Peer-reviewed literature published between 1994 and 2017 describes that comprehensive eye examination represented one of the most often applied evidence-based falls prevention interventions in studies among older adults (aged ≥ 65 years). Visual impairment is strongly associated with two or more falls in older adults and depending on the size of the eligible population, implementing just a single intervention of comprehensive eye exam could prevent between 9,563 and 45,164 medically treated falls and avert \$94–\$442 million in direct medical costs annually.^v ^{vi} In addition to poor visual acuity, visual factors such as reduced visual field, impaired contrast sensitivity and the presence of cataract may explain this association.^{vii}

According to the 2016 U.S. Census, there are 49,244,195 people age ≥65 years in the U.S.^{viii} The American Optometric Association (AOA) Health Policy Institute (HPI) research of Medicare Physician/Supplier data for optometry and ophthalmology described a total person utilization of services of 17,167,344 in 2016.^{ix} Therefore, in 2016 only 34.9% of the Medicare population of U.S. adults age ≥65 received the evidenced-based falls intervention linked to a comprehensive eye exam.

Encouraging a comprehensive eye exam to the 65.1% cohort of Medicare-eligible individuals not receiving an eye exam represents one of the highest potentials to help the greatest number of older adults in unintentional falls prevention (32.1 million).^x

Preventing Being Unintentionally Struck by or Against an Object: TBI

Visual field loss is the primary vision component that increases the risk of bumping against an object or being unintentionally struck by an object. Persons with visual field loss may benefit from comprehensive eye examination and mobility training to reduce this TBI risk.^{xi}

Being unintentionally struck by or against an object is also a prominent factor in sports-related TBI and mild TBI (mTBI), also known as concussions. An estimated 1.6-3.8 million sports- and recreation-related mTBI's occur in the U.S. each year, with football accounting for more than 60%.^{xii} While mTBI's can occur in all sports, the highest incidence rate is found in football, hockey, rugby, soccer and basketball.^{xiii}

Before the sports season begins and as part of annual comprehensive eye exams for children and adults, doctors of optometry can provide "baseline testing." Baseline testing provides benchmark comparison data to future assessments related to vision, balance, concentration and memory to determine whether patients have a mTBI or TBI after a head injury or accident. Results can also be helpful in determining when it is safe for concussed patients to return to school, work, or sports. Athletes have a heightened risk of mTBI—members of the military, patients taking ototoxic medications and older patients—and each should undergo baseline vision testing annually to assess and enhance vision and oculo-motor skills to assist prevention and diagnoses of concussions. The importance of this is highlighted by the fact that nearly one-third of child and adult athletes have sustained previously undiagnosed mTBIs^{xiv} and 10-15% will have lingering symptoms weeks after a head injury.^{xv}

It is important for patients to inform their doctors of optometry if they have experienced any bump, blow, or jolt to either the head or the body since their last visit, so their doctors can check for mTBI-related ocular issues and offer treatment or mTBI team-based referrals as needed. Among many other interventions, they can offer vision or vestibular therapy to help with symptoms related to vision and balance. Specialized glasses may be prescribed to help with light sensitivity, dizziness and blurred vision. Certain vestibular conditions may require the doctor of optometry to work with an interdisciplinary brain injury team to assist in the diagnosis and treatment of the vestibular dysfunction.

Preventing Motor Vehicle Crashes: TBI

Driving is a complex task, requiring a large range of visual, psychomotor and cognitive abilities.^{xvi} For this reason, comprehensive vision and eye health testing apart from visual acuity testing are necessary to assess cognition, balance and performance necessary for safe driving.^{xvii} A comprehensive battery of optometric testing and a well-developed therapeutic plan can be used to enhance visual skills to help avoid motor vehicle accidents, including but not limited to: peripheral vision, sharpness of eyesight, speed of recognition, focus flexibility, visual concentration, visual anticipation and visual midline appreciation.^{xviii}

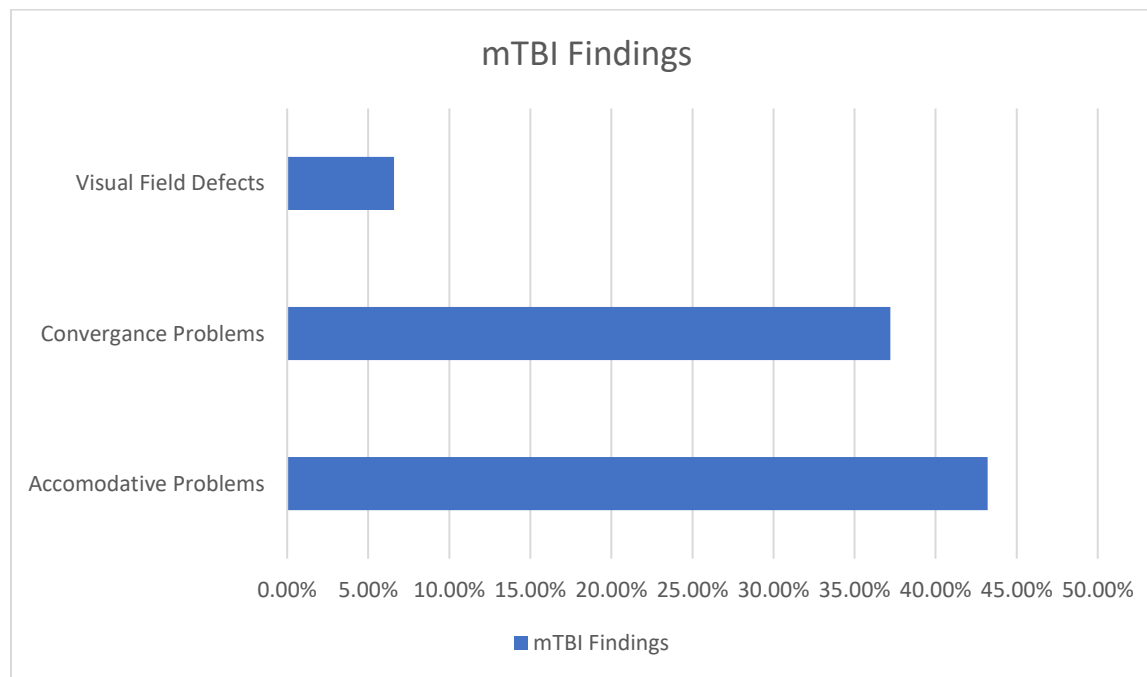
Early identification and team-based care of TBI is a shared goal among the public health and medical communities.

Early Identification and Team-based Care of TBI

Timely detection of the visual symptoms of mTBI and subsequent treatment will minimize the impact that a mTBI will have on a patient’s daily life, education and ability to work; in fact, about 90% of concussion patients have visual difficulties as a result of their injury.^{xxix} As such, doctors of optometry are essential members of the TBI health care team. Doctors of optometry can conduct comprehensive eye and vision examinations, visual perceptual and cognitive evaluations to identify concussion symptoms. Many also provide vision/vestibular rehabilitation, among other management strategies, monitor a patient’s progress and provide long-term management of concussion symptoms.

With over 50% of our brain dedicated to vision and visual processing, it is very common for the visual system to be impacted by a TBI or mTBI.^{xx} TBI and mTBI commonly cause accommodative dysfunction, wherein individuals have trouble focusing from near to far; convergence insufficiency, which renders eyes unable to work together when looking at nearby objects, causing one eye to turn outward; and oculomotor dysfunction, an eye tracking or scanning problem.^{xxi} (Table 1.0) These common conditions, which are most often detected by eye care practitioners and neurologists, can cause double or blurred vision or visual spatial processing dysfunctions. These visual system disruptions are often the origin of other common mTBI symptoms, such as headaches that are persistent and potentially debilitating.

Table 1.0: Common Findings of mTBI ^{xxii}



Adapted from Visual Deficits and Dysfunctions Associated with Traumatic Brain Injury: A Systematic Review and Meta-analysis, Optometry and Vision Science: August 2019 - Volume 96 - Issue 8 - p 542-555

Patients who suffer mTBI can also suffer from a range of visual symptoms and disorders, including problems with visual acuity, visual fields, oculomotor function, accommodative disorders, convergence insufficiency and saccadic dysfunction. Unresolved visual-vestibular issues can cause cognitive issues such

as short- and long-term memory impairment, anxiety or depression. Less common but still important to note are VOR impairments that can also result from mTBI and, for some patients, can lead to nystagmus, an involuntary eye movement that may cause the eyes to rapidly move from side to side, up and down, or in a circle, and can blur vision.^{xxiii} VOR impairment can also cause oscillopsia, a visual disturbance in which objects in the visual field appear to oscillate; oscillopsia can cause blurred or double vision and eye strain. In other words, TBI and mTBI patients might additionally complain of:^{xxiv}

- Diplopia (double vision)
- Asthenopia (eye strain)
- Blurry vision
- Difficulty tracking target/reading
- Slowed reading/reduced reading comprehension
- Eye fatigue
- Pressure sensation behind the eyes
- Photophobia (light sensitivity)

Recovery from TBI and mTBI

Because of the intimate relationship between the visual system and the vestibular system, numerous visual-vestibular complications such as coordination, balance and depth perception deficits are almost always found after TBI and mTBI.^{xxv xxvi}

Visually stimulating environments and activities often become difficult to tolerate after a concussion and can exacerbate other non-ocular symptoms, including headache.^{xxvii} These visual system complications, which frequently cause additional mTBI symptoms, can be particularly problematic in a classroom setting, when students are expected to take notes from a blackboard, interact in groups with other students on projects or activities, or function in bright, moving environments such as school hallways, recess or a visually stimulating classroom. Reading text on a printed page often presents a challenge for students with mTBI, as bouncing, shifting or blurred words and letters require more effort to process. Reading text on a computer screen can be even more difficult for students with an impaired VOR because this causes sensitivity to screen flickering or scrolling pages of text.

Understandably, academic performance, work performance in and outside of the classroom, and attendance can be negatively affected by these common mTBI symptoms. It is important for a doctor of optometry to be involved in a student's concussion care team, so they can diagnose, treat and monitor these symptoms to ensure an easier and faster post-mTBI recovery. Doctors of optometry may also help individuals and their families communicate with their schools and employers to ensure classroom and any outside work activities are considerate of the individual's post-mTBI recovery needs.

Conclusion

TBI and mTBI are a serious public health concern that can result in long-term disability if not managed properly. Doctors of optometry are a critical resource in the TBI care team and can significantly prevent TBI and mTBI and otherwise improve a patient's earlier diagnosis and recovery trajectory.

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