Article ▸ # In-Office Vision Therapy for the Treatment of Post-Concussion Syndrome: Is It Beneficial? A Case Report

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ABSTRACT

Background: Visual symptoms are present in the majority of patients following mild traumatic brain injury (mTBI) or concussion. Currently, both the severity of and the expected recovery from mTBI are assessed primarily with neuropsychological evaluation, which can be easily skewed by variable subjective responses. Because evaluation is highly subjective, proper and standard treatment for post-concussive syndrome is debatable. Visual symptoms can linger past six months; however, it is unknown whether performing vision therapy for patients with post-concussive syndrome can lessen this healing time or improve the quality of healing.

Case Report: A 20-year-old Caucasian female presented due to diplopia following mTBI three weeks prior. She was diagnosed with post-concussive fusional vergence dysfunction and accommodative paresis. Vision therapy was recommended, and she completed 23 weeks of in-office vision therapy with at-home reinforcement. Following vision therapy, she reported rare diplopia that only occurred when she was fatigued, and she felt comfortable to return to all of her activities of daily living.

Conclusion: Due to the limited objective diagnosis methods currently available following mTBI, treatment methods currently used to reduce residual visual symptoms are somewhat controversial. Additional randomized, controlled data is needed to determine the effectiveness of in-office vision therapy following mTBI compared to cognitive and physical rest. This report demonstrates a case in which visual symptoms were resolved following vision therapy.

Keywords: fusional vergence dysfunction, mTBI, post-concussion syndrome, vision therapy

Introduction

Post-concussion syndrome can be present in 20-30% of patients who previously suffered from mTBI or concussion.[1] Post-concussion syndrome varies greatly in its definition but is categorized by symptoms affecting somatic, cognitive, emotional, and sleep patterns that persist past the expected recovery time.[2] The most common post-concussive symptom is headache; however, many other visual symptoms can be present, including diplopia, photophobia, blurred vision, difficulty concentrating, and memory difficulty.[3] The length for which these symptoms can last is variable but may be days to months, which can greatly affect activities of daily living and quality of life. Commonly following mTBI, patients are evaluated with neuropsychology testing and brain imaging. Often, the injuries acquired from mTBI are unable to be detected by standard magnetic resonance imaging (MRI) or computed tomography (CT); therefore, additional testing such as functional MRI may be required. If no objective findings are possible, the patient is evaluated completely from subjective data, which can be variable and make the discussion of treatment protocols very difficult and somewhat controversial.[1] Of patients with mTBI, 74-90% have some type of visual symptom; 20% have saccadic dysfunction, and 30% have convergence insufficiency.[4] In some studies, up to 70% of patients following mTBI have been shown to have nonstrabismic deficiencies primarily affecting accommodation and vergence.[5] Many optometrists will provide vision therapy to help remedy these patients' visual symptoms by working to improve accommodative function, oculomotor accuracy and speed, and vergence stamina and control. What is not known is the benefit of vision therapy versus continued healing time without active therapy. The following case describes a patient with significant visual symptoms caused by accommodative and vergence dysfunction that was treated by vision therapy post-mTBI.

Case Report

A 20-year-old Caucasian female presented for a binocular vision evaluation due to diplopia following her most recent concussion three weeks prior. She had been struck on the forehead by a wooden chair and subsequently fell and hit the back of her head on hardwood flooring. She had no retrograde or anterograde amnesia, loss of consciousness, or seizure activity following the incident. This was her fourth concussion; her three previous all occurred while playing hockey within a six-month period approximately five years prior. She had undergone vision therapy after her last concussion due to the same complaint of diplopia. At the present time, her symptom of diplopia was described as bilateral, horizontal, and worse at near. It occurred less frequently at distance. She denied the presence of blur and eyestrain. She had been suffering from generalized headaches since her head injury, but these had been

Table 1. Baseline Binocular Vision Testing

Test	Distance	Near
Cover test	Orthophoria	8 PD exophoria
Von Graefe phorias	3 PD BI, 0 vertical	11 PD BI, 0 vertical
Worth 4 Dot	Fusion in light and dark	Fusion in light and dark
Stereopsis		140" Wirt circles 250" RDS
Near point of convergence (NPC)		45 cm break/46 cm recovery 50 cm break/54 cm recovery after 5 attempts
Near point of accommodation (NPA)		20 cm OD 20 cm OS 40 cm OU
Accommodative facility +/-2.00		9 cpm OD (slower with minus) 8 cpm OS (slower with minus) Unable OU (diplopia)
Monocular estimate method (MEM)		+2.00 OD +2.25 OS
Negative and positive relative accommodation (NRA/PRA)		+2.50 NRA -1.00 PRA
Smooth vergence ranges	x/4/2 BI x/6/2 BO	x/6/2 BI x/4/2 BO

slowly diminishing since the incident. She had not previously had any surgical procedures, and her systemic health was positive for a previous episode of idiopathic transverse myelitis that caused her to be wheelchair-bound for 12 weeks. This had occurred approximately 10 months prior. She had just discontinued amitriptyline but was actively taking 900 mg of Neurontin three times daily for residual pain from her previous episode of transverse myelitis. She reported no known allergies to medications.

Her best-corrected visual acuity with habitual contact lenses of -1.50 OU was 20/20 (6/6) OD, OS. Pupils were equal, round, and reactive to light without afferent defect. Extraocular muscle movements were full and smooth; however, she reported diplopia in primary gaze. Screening frequency doubling visual fields were performed and were full OD, OS. Colour vision testing was normal with Hardy-Rand-Rittler (HRR) OD, OS. Binocular vision testing results are shown in Table 1.

The patient was dilated with 1% tropicamide and 2.5% phenylephrine. Refraction was repeated post-dilation to confirm that excessive minus wasn't the cause for the patient's poor accommodative ability. Optic nerves were distinct, with healthy, well-perfused neuroretinal rim tissue. Both maculae were flat, with positive foveal light reflexes, and the peripheral retina was free of holes, breaks, or tears OD, OS. The patient was diagnosed with post-concussive fusional vergence dysfunction and accommodative paresis. Vision therapy was recommended to improve accommodative function, vergence reserves, and the endurance of her binocular system.

Weekly to bi-monthly in-office vision therapy with at-home reinforcement was started, and the Convergence Insufficiency Treatment Trial (CITT)[6] was used as a guideline throughout therapy. Initial therapy focused on gross vergence and feedback mechanisms. Initial activities used were Brock string, barrel card, lifesaver card, and distance/near accommodative Hart chart both at home and in the office. Once accommodation was equalized, smooth vergence activities were added, including variable Tranaglyphs and Vision Therapy Systems-III (VTS-III) vergence and multiple choice vergence activities with larger peripheral targets. Once vergence ranges appeared to be normalizing in the therapy room, re-evaluation was completed, which occurred 18 weeks after the initiation of therapy. Binocular testing from the patient's re-evaluation can be found in Table 2.

Table 2. Re-evaluation after 18 Weeks of In-Office Therapy with At-Home Reinforcement

Test	Distance	Near
Cover test	Orthophoria	8 PD exophoria
Stereopsis		30" Wirt circles 250" RDS
Near point of convergence (NPC)		BON (Bridge of nose) BON after 5 attempts
Near point of accommodation (NPA)		8 cm OD 6 cm OS 5 cm OU
Accommodative facility +/-2.00		19 cpm OD (equal plus vs minus) 20 cpm OS (equal plus vs minus) 14 cpm OU (slower with minus)
Monocular estimate method (MEM)		+1.50 OD +1.25 OS
Negative and positive relative accommodation (NRA/PRA)		+1.75 NRA -0.75 PRA
Smooth vergence ranges	x/8/4 BI x/18/12 BO	x/20/18 BI x/26/16 BO

After 18 weeks of therapy, the patient was noticing diplopia 2-3 days a week that only occurred at the end of the day for 2-3 seconds per occurrence. During her 18 weeks of therapy, she was very compliant with the home activities prescribed and would dedicate 20 minuntes to therapy activities daily. Given overall normal vergence amplitude, especially at near, it was recommended that her therapy transition from stamina and range extension to flexibility and endurance. She completed an additional 5 weekly sessions of therapy, with the majority of the time spent working on vergence jumps with non-variable Tranaglyphs, aperture rule, VTS-III jump ductions, Wheatstone variable mirror stereoscope, Brock string with prism jumps, and binocular accommodative hopping with +/-2.00. All of these activities were performed with small central targets versus the larger peripheral targets that were used during range extension. Following these 5 sessions, the patient was re-evaluated again. Stereoacuity improved to 20" (+)RDS, and additional BI range extension was seen at both distance and near. Additionally, she had equal preference for plus/minus and BI/BO with all facility testing.

Discussion

Concussion diagnosis and management continues to be a topic growing in popularity in the research. Difficulty that providers have with managing and treating patients following mTBI is a lack of credibility in both the diagnosis and management of patients post-mTBI, especially from an objective visual standpoint. Currently, neuropsychological evaluations are the accepted method of determining the extent of mTBI; however, they can be easily skewed by many things such as malingering, education, socioeconomic class, and litigation issues. As a result, researchers are currently searching for additional objective measurements that can assess whether patients have residual post-concussion syndrome.[1] Since eye movement function is controlled by subcortical, cortical, and cerebellar function, and since concussions affect motor control, eye movements may provide the key to improved diagnosis.[1] Heitger et al. found that as symptoms increased, eye movement control became increasingly impaired.[1] This discovery may provide support that optometrists need to look at saccadic, and more importantly, overall visual function in order to diagnose mTBI more accurately. This may in turn help support the need to provide rehabilitation for patients with post-concussion symptoms and subsequent oculomotor deficiencies after the expected mTBI recovery time.[1] Although without baseline oculomotor function it may potentially be difficult to quantify, perhaps measuring vergence and accommodation objectively along with oculomotor control would provide another sensitive and objective way of evaluating post-concussion syndrome.

Currently, patients who are symptomatic following mTBI are recommended only cognitive and physical rest, and when symptoms linger past a few weeks, there are variable guidelines for treatment of these patients.[1,2] Treatment in the form of vision therapy is commonly performed for accommodation, vergence, and oculomotor dysfunctions in pediatric patients who show deficits in the development of these pathways. The CITT showed that in patients aged nine to seventeen years without previous head injury, in-office vision therapy with at-home reinforcement was more effective than placebo-based in-office vision therapy and at-home pencil pushups.[6] This study, however, did not address the effectiveness of in-office vision therapy for post-concussion syndrome. A study performed by Thiagarajan and Ciuffreda at the State University of New York College of Optometry compared the effect of oculomotor rehabilitation on vergence responsiveness compared to placebo training for patients following mTBI. Oculomotor rehabilitation lasted six weeks and included nine hours of therapy: three hours each for accommodation, vergence, and versions. They found that following rehabilitation, peak velocity for convergence and divergence amplitude increased, as well as maximal convergence amplitude, fusional amplitude, and stereopsis. In addition, patient symptoms were significantly reduced and visual attention improved. These findings were not found with placebo training.[5]

Conclusion

Because post-concussive syndrome is so prevalent, especially with athletes and military individuals, and visual symptoms are very common following mTBI, it is important that optometrists continue to look at treatment options for these patients and determine with randomized, controlled studies whether performing vision therapy to improve vergence, accommodation, and saccadic/pursuit control can improve quality of life and speed of recovery following mTBI, as suspected given current clinical research.

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