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Concussion-Related Vision Disorder Practice Patterns in Occupational Therapy: A Survey

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Abstract

Background: Occupational therapists are among the first providers to initiate care after a concussion; however, evidence is limited regarding current concussion-related vision disorder practice patterns. A better understanding of these practice patterns is important because of the impact of undetected and untreated vision problems on occupational performance.

Method: A mixed-methods survey was administered online to occupational therapists to explore the assessments and interventions used to address concussion-related vision disorders, occupational therapy's perceived role, and difficulties encountered when treating these conditions.

Results: Of 23,910 occupational therapists invited to participate, 2,278 (10%) began the survey, and 1,187 (52%) met inclusion criteria. Assessment tools identified were subjective and objective in nature. Identification and treatment varied significantly based on years of practice, whether an optometrist was on site, and whether vision continuing education was completed. Identified roles included ADLs, compensation, and identification. Treatment difficulties included resources, education, and evidence.

Conclusion: Data revealed inconsistent practice patterns, perhaps because of educational differences. The results suggested improving education in the areas of concussion and vision by developing interprofessional collaboration and standards of care, developing a vision remediation certification, and producing further research regarding concussion-related vision disorders and occupation in the occupational therapy literature.

Comments

The authors report no potential conflicts of interest. Elements of this manuscript, including concussion-related vision disorder practice patterns in occupational therapy, were presented at the American Academy of Optometry Conference in November, 2018, and the American Occupational Therapy Association Conference in April, 2019.

Keywords

accommodation, convergence, interprofessional, optometry, remediation, role

Cover Page Footnote

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Credentials Display

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The Centers for Disease Control and Prevention (CDC, 2019) have estimated that in 2014, 2.87 million people sustained a traumatic brain injury and presented to the emergency room. Concussion, considered to be a mild traumatic brain injury, occurs from an external force to the head or neck and “typically results in the rapid onset of short-lived impairment of neurological function that resolves spontaneously” (McCrory et al., 2017, p. 839) where “damage to the neurofilaments and microtubules leads to axonal dysfunction and potential for disconnection” (Giza & Hovda, 2014, p. 3). Most patients sustaining a concussion recover in a 7 to 10-day period, according to Leddy and Willer (2013); however, some individuals may experience symptoms well past 3 months after onset.

Studies have identified four main categories of persistent symptoms among those slow to recover. These symptoms include physical, cognitive, visual, sleep, and psychosocial disturbances impacting functional performance (Berger et al., 2016; Gagnon et al., 2016; Gallaway et al., 2017; Gibson et al., 2013; Marshall et al., 2015; Swanson et al., 2017; Vargo et al., 2016). Persistent symptoms, defined by the Berlin expert consensus panel, “should reflect failure of normal clinical recovery—that is, symptoms that persist beyond expected time frames (i.e., > 10–14 days in adults and > 4 weeks in children)” (McCrory et al., 2017, p. 842). Yet, not everyone who has postconcussion syndrome presents in the same manner, and some may have prominent symptoms in just one of the categories, which can impact both treatment and recovery.

To help delineate evidence-based multidisciplinary interventions for complicated symptom recovery, Ellis et al. (2015) identified specific subtypes of postconcussion syndrome. These included physiologic, vestibulo-ocular, and cervicogenic domains, based on the reported persistent symptoms and manifestations. In addition, grounded in these three subtypes of postconcussion syndrome, Collins et al. (2013) developed clinical trajectories for rehabilitation to consider as protocols for those slow to recover. These trajectories are broken down into vestibular, ocular motor, anxiety and mood, post-traumatic migraine, and cervical pathways to address specific problems affecting occupation. Thus, all of these classification systems include a postconcussion syndrome subtype in which visual issues are the primary concern.

Persistent symptoms related to the vision subtype of postconcussion syndrome can limit individuals from full return to activity, including school and work, and should be addressed by an interprofessional team (Broglie et al., 2015; McCrory et al., 2017). However, the “Consensus Statement on Concussion in Sport” (McCrory et al., 2017) only vaguely discusses the occurrence of these oculomotor dysfunctions resulting from concussion and, even then, it is in terms of neurology addressing the disturbance, not optometry or any other discipline. Visual symptom management and treatment of vision dysfunction definitively fall in the scope of practice and competency of optometry. With vision also being embedded in the *Occupational Therapy Practice Framework* as a client factor impacting occupations, performance skills and performances patterns, and context and environment, the profession of occupational therapy also should play a major role in this postconcussion syndrome subtype (American Occupational Therapy Association [AOTA], 2014a; AOTA, 2014b; American Optometric Association, 1999; Williams et al., 1999).

Optometry and Concussion-Related Vision Disorders

Several studies in the field of optometry show emerging evidence on the prevalence of vision disorders after concussion for both children and adults (Alvarez et al., 2012; Master et al., 2016; Raghuram et al., 2019), the effects of remediation (Conrad et al., 2017; Gallaway et al., 2017; Scheiman et al., 2005; Scheiman et al., 2017; Thiagarajan & Ciuffreda, 2014a; Thiagarajan & Ciuffreda, 2014b),

and concussion-related vision disorder's impact on school and overall performance skills (Gagnon et al., 2016; Greenwald et al., 2012; Swanson et al., 2017). However, there is no established standard of practice in the concussion literature to establish how these concussion-related vision disorders are identified or by whom. Because of this, Carter (2018) suggests that vision problems may not be identified or considered an essential component in concussion rehabilitation. In addition, "undetected vestibular and ocular motor deficits suggest the brain is not fully healed" (Collins et al., 2013, p. 10) and can impact occupational performance at various levels and prolong recovery.

In order for concussion-related vision disorders to be detected, an eye-care professional should be involved in performing the vision examination, using a 3-component model of vision. This model includes the categories of visual integrity, visual efficiency, and visual perceptual deficits, all of which can impact occupational performance if deficient. Whether an eye examination includes all three of these components, or just an assessment of visual integrity, plays a major role in determining the outcome of the examination and, subsequently, the care provided to the client. This 3-component model of visual integrity includes the areas of visual acuity, refraction (optics of the eye), and eye health. Both optometrists and ophthalmologists examine this component. The visual efficiency category includes accommodation (focusing to see clearly), binocular vision (fusing two images into one), and ocular motility (fixations, saccades, and pursuits), while visual information processing includes visual spatial, visual analysis, and visual motor integration skills (Scheiman, 2011). These last two categories of visual efficiency and visual information processing are specific to the field of optometry.

The American Optometric Association's position paper on "Optometric Care of the Patient with Acquired Brain Injury" (1999) describes the role of the optometrist as a consultant to the rehabilitation team, providing both remediation and guidance. Optometric evaluation for acquired brain injury (ABI) includes an eye and vision examination, sensorimotor evaluation, visual information processing assessment, low vision evaluation, visual field assessment, and electrodiagnostic testing. Treatment addressing those deficits identified, along with counseling and consultation with others, is also a function of the optometrist. Those professionals that use this 3-component model may be neuro-optometrists, behavioral optometrists, or developmental optometrists.

Once these vision disorders are identified by the optometrist, treatment is then performed in the office by the optometrist or a vision therapist trained in vision remediation (Scheiman & Wick, 2020). A vision therapist can be certified by the College of Vision Development and understands that the key to remediation during treatment is separating the accommodative and vergence planes (Scheiman & Wick, 2020) using equipment, such as Aperture Rule, Vectograms, Brock String, and Eccentric Circles, with the additional use of prisms and lenses to grade the intervention. These techniques are optometry specific and used to improve accommodative and vergence skills. All vision therapists must work under the guidance of an optometrist (Scheiman & Wick, 2020).

The emphasis of optometric remediation of vision disorders is to normalize or improve function of the identified deficit. If a client has difficulty converging their eyes, for example, optometric vision rehabilitation is designed to improve the ability to converge using specific remedial therapy procedures. This approach may differ from occupational therapy in which the remediation may occur in the context of occupations. It has been suggested by Powell and Torgeson (2011) that there is an overlap in knowledge, yet, "each field also defines, evaluates, and treats the problems differently based on expertise that is not held by most practitioners in the other discipline" (p. 385). Scheiman (2011) concurs, noting that

occupational therapists use activities of daily living (ADLs) and occupational performance to improve function; optometrists address the affected function directly.

Occupational Therapy and Concussion-Related Vision Disorders

Occupational therapists use remediation in other areas of practice, especially neurological rehabilitation, and are justified to do so using various frames of reference beyond the scope of this article (Bass et al., 2017; Law & Baum, 2017; Muratori et al., 2013). The remediation techniques noted above used by the field of optometry, however, are not proficiencies that occupational therapists typically have, and the use of lenses and prism does not fall in the scope of occupational therapy for concussion-related vision disorders (AOTA, 2014b). Yet, occupational therapists are trained to assess performance components that interfere with function (AOTA, 2014a), vision being one of those. Performance skills, based on task characteristics, stages of learning, practice conditions, and feedback can improve concussion-related vision disorders, as evidenced-based research in optometry has shown (Thiagarajan & Ciuffreda, 2014a). Performance skill improvement allows for increased ability to perform occupations interrupted by concussion-related vision disorders, like reading, screen time tasks, and hobbies. By remediating these foundational performance skills, one can improve performance in occupation and resume premorbid occupational roles.

AOTA has published several critically appraised topics on the evidence of occupational therapy interventions and traumatic brain injury regarding vision and visual processing. Topics include evidence regarding improved occupational performance for those with visual and perceptual impairments when using cognitive strategies, adaptive strategies, scanning interventions, and vision therapy interventions (AOTA, 2015a; AOTA, 2015b; AOTA, 2015c; AOTA, 2015d). All four of these topic papers indicate evidence for these interventions to be considered when treating those with visual and perceptual impairments secondary to traumatic brain injury. Prior to intervention, Finn and Waskiewicz (2015) state “specific areas for occupational therapists to assess with a client post-concussion include vision and visual-perceptual deficits, cognitive and sensory processing skills, and the ability to complete activities related to self-care, work, school, leisure, and play” (p. 1). Occupational therapists can establish accommodations for schoolwork following return-to-learn guidelines in conjunction with the school staff. They can also provide sensory education on concussion symptom management, develop psychosocial coping strategies if mood and anxiety changes occur, and intervene with visual efficiency strategies required for school-based tasks to improve quality of life, participation, and well-being (Finn & Waskiewicz, 2015; Goslitz, 2009; Radomski et al., 2014; Stoffel & Tomar, 2014).

Brayton-Chung et al. (2016) describe how concussion-related vision disorders fall well in the physical symptom subtype of postconcussion syndrome described earlier and how occupational therapists can assess and treat these disorders through visual adaptations and collaborative care with an optometrist. They identify specific objective measures to assess concussion-related vision disorders in occupational therapy in order to develop functional goals in specific tasks. In addition, Berryman and Ravage (2011; Berryman et al., 2020) agree that occupational therapists are key contributors to addressing visual impairments in the ABI population from evaluation through intervention. They also identify as functions of the occupational therapist assessing and treating the areas of visual perception, visual-motor integration, and participation in ADLs that involve visual input, like driving. This can be done through a basic vision screening, formal assessment, and observation during functional activity. They ultimately suggest a collaborative approach, as “occupational therapists are skilled at providing compensatory

strategies for visual impairments, but lack comprehensive knowledge regarding remedial visual interventions” (p. 33).

Multidisciplinary Approach

The fundamental goal of both optometry and occupational therapy is to improve the patient’s quality of life in regard to occupational performance (AOTA, 2014a; American Optometric Association, 1999). With optometry at the helm of visual dysfunction and remediation, and occupational therapy at the helm of ADLs and resuming life roles, it is believed these two disciplines working together can fill the gap of returning to occupation sooner than current models. Radomski et al. (2016) supports this notion, suggesting, “occupational therapy practitioners may work to remediate or minimize the impairment itself before or while intervening to optimize task and role performance” (p. 6). Yet, current evidence is lacking in how these two disciplines can work together regarding concussion-related vision disorders and return to function. Specifically, evidence is lacking in how occupational therapists consistently identify and treat concussion-related vision disorders.

Current evaluation and practice patterns must be understood to identify strengths, inconsistencies, and areas for improvement prior to justifying and establishing the need for standards of practice. To best capture information regarding current patterns addressing these areas, a survey was used to gather both qualitative and quantitative data. The purpose of this study was to develop evidence about occupational therapy concussion-related vision disorder evaluation and practice patterns with emphasis on screening, treatment, collaboration with other professionals, and the profession’s role helping clients to return to occupation and activity.

Method

Prior to research initiation, institutional review board (IRB) approval was obtained. All of the participants in the survey provided informed consent. There were no conflicts of interest to declare by any of the researchers.

Sampling Method

Sample Selection

New York, Florida, Texas, California, and Pennsylvania were identified as the states with the largest number of occupational therapists, via the Bureau of Labor Statistics. The state licensing boards of California and Pennsylvania did not offer email addresses for occupational therapists; therefore, therapists from those states were excluded from the study sample, as contact was via email only. Wisconsin, another state with a large occupational therapy population, was chosen as an additional state to represent the northern Midwest region. With the addition of Wisconsin, the sample represented the Northeast, Midwest, and South geographic regions defined by the United States Census Bureau but lacked representation from the West. Attempts were made to obtain Western geographic representation; however, the state licensing boards of the states contacted either did not respond to requests, did not have email addresses for most of their licensees, or did not provide email addresses in their data. Therefore, the sample consisted of occupational therapists in the state licensing databases from Texas, Florida, Wisconsin, and New York. This yielded a large population of participants with reasonable, though not ideal, geographic representation.

Exclusion Criteria

All respondents were included except for occupational therapists who did not treat concussions, who no longer had an active license, or who changed their email addresses since obtaining their license. Occupational therapy assistants were excluded because they do not participate in the evaluative process

of concussion-related vision disorders. Respondents who received surveys but no longer practiced in the state board from which their name was obtained were still allowed to participate to increase geographic representation.

Instrument Design

Survey content was developed by two of the authors with over 60 years of combined clinical experience in their professions. Both had collaborative institutional training, initiative training, and were trained in research methods. The 41-item survey included demographics, evaluative practice patterns, treatment practice patterns, and a qualitative section regarding role, justification, and obstacles to treatment. The initial survey was pilot tested for clarity among peers in concussion rehabilitation to address face and content validity. An initial inclusion criteria question at the beginning of the survey asked, “Do you work with clients who have sustained a concussion or mild traumatic brain injury in your setting?” A negative response resulted in the conclusion of the survey.

Data Collection

Data collection was performed through a web-based platform on SurveyMonkey®. Collector settings on SurveyMonkey® were set for SSL encryption and anonymous responses. The survey was pilot tested prelaunch on phone, tablet, and desktop platforms for formatting error identification. The survey was open for data collection over a 5-week period from January 2018 to February 2018.

Data Analysis

The analysis of quantitative data was performed using SPSS version 24.0 (International Business Machines Corporation 177 [IBM], 2016). Responses to closed-ended survey questions were described by percentages. To assess whether the use of various practices was influenced by years of practice, a trend test was performed using logistic regression with years of practice as the independent variable and use or lack of use of a practice as the dependent variable. The associations of explanatory variables, such as additional certifications or proximity of optometric consultative services, with outcome variables, such as the use of specific assessments to identify concussion-related vision disorders or the provision of specific interventions, were assessed using chi-square tests of independence or Fisher’s exact test when the expected value for any cell in a contingency table was less than five. The significance level was set to 0.05.

Metadata were created, including both codes and concept maps, for the qualitative data analysis. Thematic content analysis identified primary codes and summary statements were generated. Text analysis was initially performed by SurveyMonkey®. Based on these high frequency words, additional coding was performed manually to further understand the use of such words and phrases in context. Recurring codes were identified and consolidated through the development of themes. Themes were then validated by consensus and concept maps were generated to visually show the interaction of themes as they were understood by the researcher.

Results

Quantitative Data

Professional Background

Of the 23,910 occupational therapists who were sent emails inviting them to participate in the study, “Emerging Occupational Therapy Practice Patterns,” 2,278 (10%) subjects participated in the survey. Of the 2,278, 48% (n = 1,090) were found to be ineligible with the opening question, “Do you work with clients who have sustained a concussion or mild traumatic brain injury in your setting?” Of the 1,188 who were eligible, 1,187 provided usable data and were included in the analysis. The 1,187

respondents practiced across 46 states because of dual licensure and relocation. Over 85% were female. Table 1 describes the respondents' professional background and practice characteristics.

Table 1*Professional Background and Practice Characteristics of the Respondents who Work with Clients with Concussion*

Characteristic		%
Education Highest Degree:	Baccalaureate	33
	Master's	61
	Doctorate/PhD	6
Years of Practice:	0–5 years	28
	6–10 years	14
	11–15 years	9
	15–20 years	14
	20+ years	35
Region of United States Primarily Practicing in:	South: DE, FL, GA, MD, NC, SC, VA, WV, AL, KY, MS, TN, AR, LA, OK, TX	80
	Midwest: IN, IL, MO, OH, WI, IO, KS, MN, MI, NE, ND, SD	9
	Northeast: CT, ME, MA, NH, RI, VT, NJ, NY, PA	7
	West: AZ, CO, ID, NM, MT, UT, NV, WY, AK, CA, HI, OR, WA	4
Work Setting:	Acute Care, Rehab Hospital, Sub-Acute	30
	Outpatient Adult and Pediatrics	22
	Skilled Nursing Facility	16
	Other: VA Hospital, Home Health, School	33
Percent of Caseload That is Concussion or mTBI Related:	0–25%	86
	26–50%	11
	51–75%	2
	76–100%	1
Additional Certificates:	Certified Stroke Rehab Specialist	8
	Acquired Brain Injury Specialist	4
	Low Vision Specialist	3
Educator at an Accredited OT Program		6
Agreed That Received Adequate Entry-Level Education on:	Vision	30
	Concussion Rehabilitation	16
Taken Additional Continuing Education Courses on:	Vision	57
	Concussion Rehabilitation	29
Agreed Occupational Therapists Have a Role in Treating Concussion-Related Vision Disorders		85
Would Pursue a Certificate in Remedial Vision if it Were Offered by an Optometry College/University		59

Note. $n = 1187$ participants.

Screening

Twenty-nine percent of the therapists reported specifically screening for concussion-related vision disorders during evaluation. This falls in the scope of occupational therapy as “a screening is not diagnostic; it is a method for gathering information and determining the appropriate plan of care” (Berryman & Ravage, 2011, p. 38). Of the 29% ($n = 325$) of the participants who reported screening for concussion-related vision disorders, 71% screened always or frequently for near visual acuity and 64% for far visual acuity, although the specific screening measure was not identified. Of the options offered in

the survey, functional task, over the use of an objective measure or interview or questionnaire, was used most often to identify binocularity issues (44%), accommodative issues (62%), saccadic dysfunction (46%), pursuit issues (41%), occupational performance (15%), and visual processing (46%). Again, the specific functional tasks used were not identified in the survey. Convergence was the only concussion-related vision disorder that was not identified the most often using functional tasks (38%), but instead was measured directly using the near-point of convergence break (41%).

The Brain Injury Visual Assessment Battery for Adults (biVABA), an assessment of visual processing ability used after the diagnosis of a brain injury, was used by 33% of the participants. The Vestibular Ocular Motor Screening (VOMS), a screening tool designed to detect signs and symptoms of a concussion, was used by 37% of the respondents as an objective measure to identify concussion-related vision disorders. When asked overall what concussion-related vision disorders were identified during the screening process, occupational therapists reported the following: visual field loss (16%), visual perceptual dysfunction (15%), decreased acuity (12%), binocular dysfunction/double vision (12%), accommodative dysfunction/blurry vision (11%), and saccadic dysfunction (11%). These results differ from published optometric studies regarding the frequency of concussion-related vision disorders, discussed later in this paper (Alvarez et al., 2012; Master et al., 2016; Raghuram et al., 2019). Additional descriptive frequency data can be seen in Table 2.

Table 2
Visual Screening Techniques used by Occupational Therapists During Concussion Rehabilitation Evaluations

Visual Efficiency and Visual Information Processing Skill	Percentage Using Screening Technique				
	I do not Assess	Questionnaire/ Interview	Functional Task	Objective Measure	Other
Binocularity	19	10	44	22	4
Accommodation	16	12	62	8	3
Saccades	12	4	46	31	7
Pursuits	16	4	41	29	5
Convergence	9	6	38	43	5
Visual Information Processing	3	4	46	44	3

Note. $n = 1187$ participants.

Interprofessional Collaboration

When asked who is the most helpful in diagnosing a concussion-related vision disorder, 48% identified a neurologist while 45% identified an eye care specialist. Eye care specialists included either an ophthalmologist (30%), optometrist (11%), or neuro-ophthalmologist/optometrist (4%). When asked who was the most helpful in treating concussion-related vision disorders, optometry (40%) and occupational therapy (39%) had nearly the same frequency. An interdisciplinary approach between occupational therapy and optometry was identified by an additional 1%.

Forty-eight percent of the participants specifically referred out to an eye care specialist, including ophthalmology (28%), optometry (15%), neuro-ophthalmology/optometry (5%), or neurology (31%) when suspecting a concussion-related vision disorder. Of the entire sample ($n = 1,187$), 201 (17%) had an

optometrist in their facility to examine patients suspected of having concussion-related vision disorders, while only 86 (7%) had an optometrist who actually worked with occupational therapy or another therapist to provide vision therapy. For those without an optometrist on site, optometry services were located within 20 miles for 552, or 56%, of the respondents.

Treatment

Of those who reported positively screening for concussion-related vision disorders ($n = 329$), 238 also reported treating those disorders. These disorders were treated with both occupational therapy interventions as well as interventions that are typically found in the optometric literature. Descriptive data can be found in Table 3.

Table 3

Percentage of Occupational Therapists using Concussion-Related Vision Disorder Treatment Interventions

Concussion-Related Vision Disorder Treatment Intervention	%
Handheld Device Apps	53
Pencil Pushups	41
Brock String	31
Dynavision	28
Other Vision Software	26
Aperture Rule/Barrel Cards and/or Eccentric Circles	23
Activities of Daily Living	18
Bioness Integrated Therapy System (BITS)	18
Vectograms	15
Instrumental Activities of Daily Living	14
Visual Perceptual Tasks: Parquetry, Pattern Follows	14
Eye Patching	12
Pursuit Tasks	11
Reading Tasks	11
Saccadic Tasks	10
Accommodations for Work or School	9
Hypersensitivity Education and Management	7
Fitness to Drive/Driver Rehabilitation	4
Binocular Vision Task with a Prism	3
Accommodative Task with a Lens	3
Suggestion of a Lens	3
Suggestion of a Tinted Lens	3
Other	2

Note. $n = 238$.

Influences on Care

Years of practice significantly influenced treatment strategies used by occupational therapists; those with more years of practice were more likely to use Aperture Rule, Barrel Cards and/or Eccentric Circles ($p = .007$), handheld device apps ($p = .003$), and other vision therapy software ($p = .04$). Descriptive data can be found in Table 4. The percentage of occupational therapists who used Aperture Rule and Barrel Cards and/or Eccentric Circles nearly tripled between 6–10 years of practice and 11–15 years of practice. Likewise, the same phenomenon occurred with the use of Vectograms but was not statistically significant ($p = .07$). Overall, the use of Brock String and pencil pushups remained fairly constant, regardless of years of practice. Use of other treatment strategies did not differ significantly with years of practice.

Table 4
Years of Practice Influence on Treatment Interventions

Treatment Intervention	Years of Practice: Percentages of Occupational Therapists Reporting Use				
	0–5 years	6–10 years	11–15 years	16–20 years	20+ years
Handheld Device Applications	24	62	83	57	60
Binocularity with Prism	9	19	10	14	18
Accommodation with Lens	7	11	24	14	14
Brock String	24	31	39	33	33
Pencil Pushups	30	41	56	33	43
Vectograms	7	10	28	20	16
Aperture Rule/ Barrel Cards/ Eccentric Circles	11	13	34	20	30
Other Vision Software	11	32	31	20	34

Note. $n = 238$.

The use of other vision therapy software, not including the Bioness Integrated Therapy System (BITS) or Dynavision, which are larger visual training boards, differed significantly by whether there was an optometrist on site ($p = .03$); of those with an optometrist on site, 41% reported using other vision therapy software compared to only 22% when no optometrist was on site. Although twice as many participants with an optometrist on site (22%) than without an optometrist on site (11%) used accommodative tasks with a lens, the difference was not statistically significant ($p = 0.11$). Similar differences occurred for use of a Vectogram ($p = .16$) with (23%) and without (13%) an optometrist on site. Prism ($p = .001$) and Dynavision ($p = .02$) were used significantly more often when an optometrist was on site but did not differ with continuing education training or when participants identified as an Acquired Brain Injury Specialist (ABIS). The results are shown in Table 5.

Those who took a continuing education course on concussion and those that did not differed significantly in their use of various treatment strategies. The respondents who reported taking concussion courses were significantly more likely to use a lens ($p = .003$), Brock String ($p = .001$), pencil pushups ($p = .003$), Aperture rule, Barrel Cards and/or Eccentric Circles ($p = .01$), handheld device apps ($p = .005$), and other vision therapy software ($p = .002$) than those who did not attend additional concussion courses.

Aperture rule was used significantly more often ($p = .01$) when a concussion continuing education course was taken but did not differ when a vision continuing education course was taken or when participants identified as an ABIS. Having taken continuing education courses on concussion was associated with significantly increased use of more treatment interventions than any other characteristic studied, including whether an optometrist was on site.

Taking additional vision-related continuing education courses accounted for significant increases in use of some interventions. Those taking these courses were statistically significantly more likely to use Brock String ($p = .001$), pencil pushups ($p = .001$), Vectograms ($p = .02$), hand held applications ($p = .006$), and other vision software ($p = .03$) than those who did not attend vision courses. Similarly, those who identified as an ABIS compared to those who did not, were significantly more likely to use pencil pushups, Brock String, BITS, and other vision software. Vectograms were used significantly more often ($p = .02$) only when a vision-related continuing education course was taken.

Those identifying as an educator were only significantly more likely to use Brock String ($p = .01$) and hand held applications ($p = .01$) compared to those who were not educators. Being a Certified Stroke Rehabilitation Specialist did not significantly alter the use of any treatment interventions. Lastly, for those identifying as a Certified Low Vision Therapist (CLVT), 89% reported using handheld applications as treatment compared to 49% who were not certified, which was significant ($p = .04$). Despite twice as many CLVT's using Aperture rule (44%) than those using this technique who were not CLVT's (20%), the difference was not statistically significant ($p = .10$). No other differences in use of treatment interventions were identified.

Table 5
Percentage of Occupational Therapists Using Treatment Interventions Based on Therapist Characteristics

Explanatory Variable	Prism	Lens	Brock String	Pencil Pushups	Vectograms	Aperture Rule, etc.	BITS	Dynavision	Handheld Device Apps	Other Vision Software
Optometrist On site										
Yes	32% **	22%	38%	31%	23%	32%	31%*	44%*	65%	41%*
No	12%	11%	29%	42%	13%	19%	15%	24%	49%	22%
Concussion CEU Taken										
Yes	9%	0%**	1%**	0%**	9%	8%*	1%	2%	62%*	35%*
No	12%	6%	19%	28%	9%	12%	14%	24%	41%	15%
Vision CEU Taken										
Yes	18%	16%	38%**	47%**	18%*	24%	19%	29%	57%**	31%*
No	9%	7%	10%	17%	3%	14%	15%	26%	33%	13%
Identified as an ABIS										
Yes	26%	26%	60%*	73%**	23%	43%	43%*	40%	73%	54%*
No	15%	13%	29%	37%	14%	20%	15%	25%	49%	23%

Note. $n = 232$. The occupational therapists who reported treating concussion-related vision disorders are included in this table. The sample size varies from 238 to 232 because of missing data. Bold indicates statistically significant difference between those with and without the explanatory variable with a level of significance indicated by asterisks: * $p < 0.05$; ** $p < 0.01$. For example, the difference in the proportion of occupational therapists using a prism was significantly higher when an optometrist was on site (32%) compared to those without an optometrist on site (12%), $p < 0.01$.

Qualitative Data

Role

Occupational therapy was identified as having a role in treating concussion-related vision disorders by 85% of those meeting the inclusion criteria. Using both manual and computer-assisted qualitative data analysis for those who did acknowledge a role, thematic codes of the responses to the open-ended question “What is that role?” were identified to generate a summary statement for each code (Giles et al., 2014). Overarching themes identified in those recurring codes included using ADLs, adapting or compensating a task, and identifying concussion-related vision disorders.

The ADLs theme was composed of participants reporting the use of instrumental activities of daily living (IADLs), functional activities, roles and accommodations, aspects regarding quality of life, and community reintegration or return to activity. The adaptation or compensatory theme included adapting the environment to prevent falls and improve safety, educating the patient and family on various strategies, or using adaptive equipment and low-vision techniques for improvement with function. Lastly, participant report of concussion-related vision disorder identification was comprised of topics mentioning treatment with visual perception techniques, scanning and eye exercises, referring to an eye-care specialist for interdisciplinary care, remediation of the disorder, and performing “vision therapy.”

This reported role of improving vision, the role of remediation of the visual deficits, was debatable among the participants. Participant 1 stated, “As an OT, my goal is to work on occupations that are in jeopardy because of an impairment—not treat the impairment.” In comparison, Participant 2 suggested,

We try to ensure the best and safest transition home possible through the use of the following methods: we provide eye patches and vision/occluded glasses for double vision, we have patients perform visual tasks through scanning, saccadic movements, pursuits, convergence/divergence, accommodation, visual perception, etc., for the purpose of identifying environmental barriers. In addition, we also use compensatory methods through utilizing other senses, such as auditory and tactile, for safety when vision is impaired.

This dichotomy will be explored later in the discussion section.

Difficulties

Because of a hypothesis of inconsistencies in practice patterns and referrals based on current clinical experience, the open-ended question “What is the biggest problem you face when treating concussion-related vision disorders?” was also asked and coded. Many consistent ideas emerged in the answers to this question. Resulting themes were condensed into three categories, including resources, education, and evidence.

Resources were described as lack of equipment, decreased department budget, and time, including the short length of time in a setting to conduct screenings and the time it takes for referrals to occur. Also placed in this theme of resources was the lack of a nearby optometry provider, or the time it takes to be seen because of long provider wait lists and limited insurance coverage and the cost of vision therapy. Participants 3 and 4 identified “Not having enough trained therapists and optometrists to work with vision disorders” and “Distance to a certified vision specialist as I practice in a very rural community” as issues, which were also echoed by others. When clinical staffing was not identified, resources like insurance coverage was mentioned. When asked about difficulties with treatment, Participant 5 stated,

“Coverage. Few OD’s [optometrists] are doing it [vision therapy] and [the patients wind up] self-paying as insurance reimbursement to OD is so low.”

The second theme of education included lack of medical provider knowledge to refer or diagnose and decreased compliance of family and patient with follow-up care because of a lack of understanding the impact of the disorder. Also, of note, was the lack of occupational therapy protocol or education, lack of support by interdisciplinary providers to refer and identify the disorder, and the lack of interdisciplinary teamwork between occupational therapy and optometry. Many participants simply stated “Lack of knowledge.” This term could apply to lack of knowledge of providers, occupational therapists, or the benefits of treatment. A sixth participant elaborated, stating,

There is a lack of knowledge of the benefits of vision therapy. Many optometrists say that vision therapy is unproven or not needed, however, I strongly believe that vision therapy is underrated by MDs, that doctor’s need more education in the area. I have seen huge gains from clients who have done vision therapy.

Participant 7 stated, “I feel that the physicians in my area are not aware of the skill set that OTs have related to vision. I strongly feel we are underutilized and that physicians do not refer patients to us enough.”

Interprofessional teamwork was also noted as an issue. “Having an ophthalmologist/optometrist that understands and are (sic) willing to work with OT with treating visual issues,” is a problem, stated Participant 8. Several see it as an emerging practice for occupational therapists, like Participant 9. “I feel like it is a specialty that is an emerging niche. It would be beneficial to have OT-based CEUs.”

Tying in with education, the theme of evidence incorporated the lack of evidence-based research on remediation and vision therapy, and the lack of treatment protocol in the occupational therapy practice framework. One problem identified by Participant 10 was “having current evidence-based data on treatment strategies and buy-in support from management.” After identifying a lack of providers to refer clients, Participant 11 mentioned “access to strong evidence-based vision therapy strategies.” Another identified all three themes simultaneously: “Having enough time to educate other medical professionals, insurance, ophthalmologist, etc., about the impact of concussion/TBI on vision, role of vision therapy, and case studies with historical and scientific proof of outcomes.” As this participant identified, the themes are intertwined, impacting each other in addition to standing alone. For example, management may not be educated on the impact of concussion-related vision disorders on occupational performance to approve equipment needed to treat the disorder because there is limited evidence to justify the treatment. See Figure 1 for this qualitative theme interplay.

Discussion

Emerging Themes

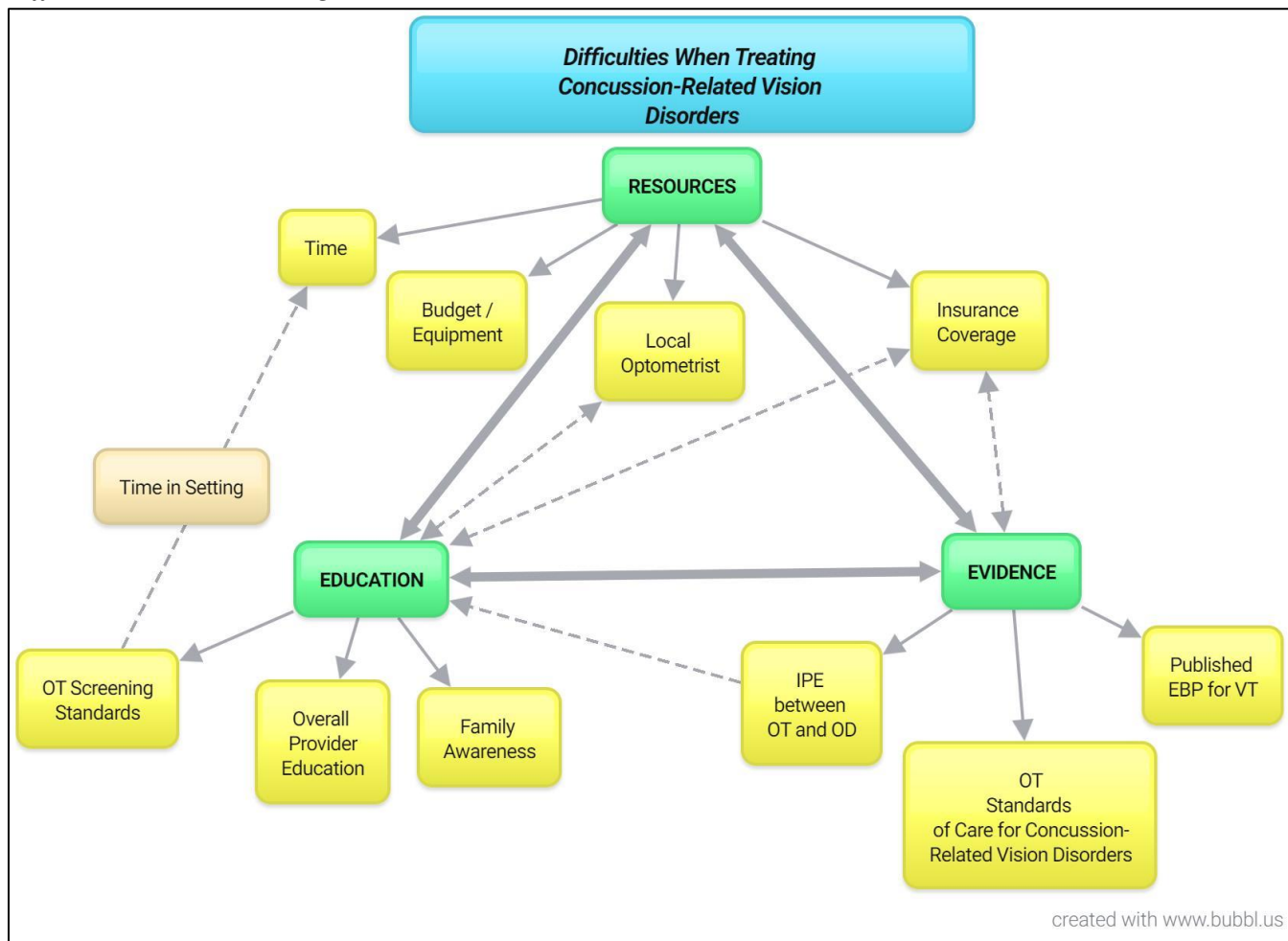
Concussion-Related Vision Disorder Identification

The results from this study revealed that only 29% of occupational therapists (n = 1187) who perform concussion rehabilitation actually screen for concussion-related vision disorders during initial evaluation. Therefore, 71% of occupational therapists surveyed did not recognize the potential for this disorder during their evaluation. This data identifies a gap in practice. However, out of those who do screen and answered the open-ended question, “What is occupational therapy’s role” (n = 619), many named identification of the disorder as occupational therapy’s primary role. These findings suggest that occupational therapists that do not screen may be unaware of the frequency of these disorders, compared

to those who do screen. For example, of the 65 respondents that stated they have encountered no issues when treating concussion-related vision disorders or that it is a very rare condition, only four positively identified actually screening for concussion-related vision disorders. A disorder cannot be identified if a screening is not performed.

Figure 1

Difficulties When Treating Concussion-Related Vision Disorders



Note. Thematic codes for occupational therapy's difficulties when treating concussion-related vision disorders. Thick solid arrows reflect the main themes identified by the participants. Thin arrows identify the most frequently reported sub-categories in each topic. Dashed arrows indicate the interplay between all topics, regardless of domain. Definitions: IPE- Interprofessional Education; VT- Vision Therapy; Provider- all involved medical professionals.

Of those respondents who stated that they screen for vision problems, most used functional performance to identify those disorders, including ADLs and IADLs. Using functional activity is certainly grounded in the framework of occupational therapy. However, using only functional activity screens, rather than standardized clinical measures, likely results in under identification of concussion-related vision disorders.

The survey results indicated occupational therapists reported visual field loss (16%) as the vision disorder most commonly identified in this population. However, the literature on concussion-related vision disorders indicates that convergence insufficiency, accommodative insufficiency, and saccadic dysfunction are the most prevalent conditions after concussion (Alvarez et al., 2012; Master et al., 2016;

Raghuram et al., 2019). Occupational therapists who do not perform a structured vision screening designed to identify accommodative, binocular vision, and eye movement disorders may be missing the more common concussion-related vision disorders. This has significant implications for the success of other more traditional occupational therapy interventions, such as ADLs, IADLs, and return-to-learn if not properly identified.

This lack of identification may also be due to therapists not referring out to professionals who are best positioned and likely to perform the testing necessary to diagnose concussion-related vision disorders. The survey results indicated that therapists are referring out to neurology more frequently than eye-care specialists for diagnosis. In addition, when referring to an eye care specialist, ophthalmology was chosen more often than optometry despite the disparity in the models of vision of the two professions (Scheiman, 2011), with optometry generally using a more comprehensive 3-component model of vision discussed earlier. There also did not appear to be an understanding that there are differences even in the profession of optometry in regard to the likelihood of a comprehensive examination being performed. This appears to be because of a lack of understanding and knowledge about which eye-care clinicians are most likely to be helpful for this particular population. This is supported, as well, based on qualitative survey data suggesting a lack of optometric resources as a difficulty when treating concussion-related vision disorders.

The theme regarding identification of concussion-related vision disorders and referral to optometry suggested occupational therapists want to work as a member of an interprofessional team to improve the occupational performance of their clients. Some, like Participant 11, mention the role of occupational therapy is to “Identify how the vision disorder affects the patient’s ability with ADL/IADL tasks and treat or refer to the appropriate discipline for treatment.” However, although this was a small percentage (less than 2%), others feel occupational therapy can identify and treat simultaneously without any guidance from an eye-care professional. This suggests a lack of consensus about scope and best practice standards in occupational therapy. Without such standards, it would be expected that there would be inconsistent practice patterns and understanding of the role of occupational therapy relative to concussion-related vision disorders.

Another inconsistency was that, when identified, occupational therapists reported using optometric strategies, like Brock String, lens, pencil pushups, and Vectograms, typically used for treatment with accommodative and convergence disorders. Yet as noted above, occupational therapists were not screening with objective measures to identify those disorders. It is possible that based on subjective reports of blurred or double vision, occupational therapists use these strategies without proper diagnostics, guidance, or justification. Further study is needed to correlate the usage of these strategies with interprofessional education and understanding of treatment.

Education

Inconsistent practice patterns can also occur because of lack of education. Only 30% reported receiving adequate entry-level education on vision, while only 16% reported adequate entry-level education on concussion. Therapists that attended additional continuing education courses about concussion used significantly more optometric treatment strategies, even more so than those that attended continuing education courses about vision. Concussion-related courses may or may not be taught by someone with an optometric background. It is likely that vision-related courses are taught by an optometrist, who strongly encourages interprofessional collaboration with treatment strategies, versus concussion courses that solely offer information on what treatment strategies are used by all professions,

not adhering to scope consideration. Further study is needed to investigate this relationship.

Also noteworthy was the therapists that identified themselves as educators in occupational therapy programs reported using a vision therapy procedure, Brock String, more than twice as often (64%) than therapists who were not educators (29%). The survey was not designed to investigate the amount of optometry-based evidence these clinicians had learned to support the use of these techniques. It may be that because educators use Brock String and hand held applications significantly more, that treating therapists educated by these individuals also use these interventions significantly more often. Further study is also needed in this area to explore this connection.

Remediation

This theme of remediating the visual dysfunction and providing scanning tasks, visual information processing, eye exercises, and home exercise programs suggests that occupational therapists feel they already have the skill set to intervene and treat these disorders, with or without the help of optometry, as suggested by Participant 12.

We are well suited to treating a client from a holistic perspective and helping to address the everyday functionality. As such, we may be the first to be able to identify vision concerns as they present themselves during functional tasks. We can easily incorporate vision training tasks into current goal-oriented tasks so that the client more seamlessly develops the skills. This is more cost effective and likely more successful for a patient versus just isolated vision training.

Several were in agreement with this statement, but quantified this in the qualitative portion by saying, “with proper training”. In the responses, there was a definite dichotomy as to whether the respondents felt occupational therapy was able to provide treatment alone, as part of a team, with or without additional training. “Our role is extensive. Referral to OD, who has impeccable knowledge of neurological optometrics (sic), is critical. Once a thorough evaluation is achieved, we then assume the responsibility of facilitating the rehabilitation of all neuromotor responses,” stated a 13th respondent.

Hence, remediation of vision can be controversial in the field of occupational therapy. In personal communication with Mary Warren, she felt that the only role occupational therapists have in concussion-related vision disorders is compensatory in nature and that remediation should only fall in the scope of optometry. “The goal of occupational therapy is participation, not convergence” (M. Warren, personal communication, September 20, 2017). She suggests that if a patient has trouble reading, the goal of occupational therapy is to get the client the information they need via audiobooks or other adaptive strategies. “We do not need to restore.”

The occupational therapists who took the survey, however, strongly disagreed. “Such diversity represents a healthy growth in our profession as we deepen our understanding of what we do” (Kramer et al., 2017, p. 348). Phrases mentioned throughout the survey results for occupational therapy’s role included, “reintegration of the visual motor system,” “help re-educate and train brain and vision function,” “visual remediation,” and “improving visual function.” Models in the occupational therapy literature justify the remediation of neurological dysfunction to improve occupational performance and function.

The occupational therapist uses a combination of occupational readiness methods or preparatory techniques . . . as means to empower the occupational adaptation process. [These] techniques focus on underlying client skill and functioning of the body to help the client optimally participate in occupations. (Grajo, 2017, p. 301)

There is emerging evidence that concussion-related vision disorders respond to remedial vision rehabilitation. Yet, when appropriate, well-trained optometric providers are scarce, as reported by many in this survey, occupational therapy could be next in line to fill the void through remediation and occupation. However, optometrists would argue that this should only be done with optometric collaboration and co-management (Scheiman, 2011).

Interprofessional Care

Those therapists with an optometrist on site were significantly more likely to use a prism for binocular dysfunction or other vision therapy software than those who did not have an optometrist on site. This suggests that optometrists may provide guidance in recommending treatment options and are willing to have occupational therapists assist in the remediation of concussion-related vision disorders. In contrast, for those with an optometrist on site, there was no significant difference in using a lens for accommodative dysfunction. This suggests that occupational therapists may be using this treatment intervention without additional guidance. This result may be aided by continuing education courses offering vision remediation strategies discussed earlier. It should be noted that the use of lenses and prism is considered the practice of optometry in all states and the use of these devices by an occupational therapist without optometric input is likely problematic from a medicolegal standpoint.

As a respondent suggested earlier in this paper, many see this as an emerging field for occupational therapy. Participant 14 suggests there should be “a specialty certification in that area to make OT marketable for this.” “With increased continuing education, OTs are an appropriate discipline to provide vision therapy due to our unique skill set,” echoes participants 15 and 16. “This could be a new field for OT. OT has a good understanding of brain injury and recovery.” Supporting this idea, 59% of the survey respondents indicated they would pursue a certificate in remedial vision rehabilitation for ABI if it were offered by an optometry college or university for ensured competency in the occupational therapy profession.

Limitations

Despite a large sample size, limitations include a heavy representation from the South, which may limit the generalizability of the study. Despite over 24,000 surveys being distributed, there was a response rate of only 10%. Therefore, it is possible that those who responded differ from those who did not and that our results are not representative of all of the occupational therapists to whom the survey was sent. Because of the inconsistent definitions of vision rehabilitation and vision therapy in the occupational therapy community, there could be a misunderstanding in the terms used in the survey despite efforts to quantify those definitions.

Implications for Occupational Therapy Practice and Research

This study suggests several potential areas of change in occupational therapy practice. Data indicates there is a need for more education for entry-level therapists on proper vision screening techniques to establish both position papers and standards of care for concussion-related vision disorders to ensure competency in the field of occupational therapy. There is also a need to develop entry-level education about the various eye care professionals, models of vision, and which professionals are most likely to help therapists manage concussion-related vision disorders. Lastly, additional advanced training for occupational therapists to prepare them to participate in remedial vision rehabilitation, similar to the Low Vision Therapist Certification offered through AOTA, is desired.

This study, exploratory in nature, regarding current concussion-related vision disorder practice patterns in occupational therapy, raises many opportunities for further research. Topics identified include

establishing the benefits of concussion-related vision disorder remediation on occupational performance. In addition, investigation into occupational therapy concussion-related vision practice patterns comparing specific settings should be considered, including pediatrics, acute care, and other neurological populations. This could include identifying referral sources to occupational therapy, based on different practice settings. It is also imperative to understand those referral sources' perceptions of occupational therapy's role in treatment of concussion-related vision disorders and why other disciplines do or do not refer to occupational therapy. Exploration into the preference of referring to a vision therapist over an occupational therapist could also be pursued. A final area to consider includes how concussion and vision continuing education courses, geared toward occupational therapists, differ in presentation on concussion-related vision screening and treatment practices.

Conclusion

Data revealed that current practice patterns are inconsistent and that a lack of entry-level and postgraduate education may play a role in these inconsistencies. Occupational therapists are not consistently screening for concussion-related vision disorders, despite their role as early medical providers. When they do screen, they are using functional activity as the primary way to identify vision disorders, which could result in under identification of concussion-related vision disorders diagnosis in many cases. These data indicate a potential area of growth in the profession. Referrals to optometry for diagnosis and treatment are superseded by referrals to neurology and ophthalmology, also allowing for the omission of proper diagnosis identification. This indicates another area of growth regarding interprofessional education.

Some occupational therapists believe they are equally qualified in providing concussion-related vision disorder treatment as optometry. They also feel that this role is justified in occupational therapy models and frameworks. Some use occupation-based strategies, including ADLs, reading, and compensatory strategies with tasks. This includes addressing return-to-learn, described mostly as role resumption and return to work or school. Others use a more controversial approach in the field and treat concussion-related vision disorders with a dynamic systems theory approach of remediation.

The data from this study suggests that there is no set standard of practice regarding intervention and treatment for concussion-related vision disorders by occupational therapists across the country. More studies like Berryman et al. (2020) need to be conducted to establish evidence for best practice. Data also suggests that occupational therapy is uncertain of whom to refer for proper identification but want to work with eye care specialists in the remediation of this problem to improve occupational performance. Many identified that proper training is required to pursue this collaboration. Many also favored establishing a certification in the field of occupational therapy to ensure competency, and nearly 60% indicated an interest in pursuing that certificate, if it were made available.

Overall, the results of this study indicated that occupational therapists do play a role in concussion-related vision disorders and feel that they have the foundational skill set to do so. Prior to the completion of this study, practice patterns in this area were not identified. To ensure competency in the profession of occupational therapy, position papers can now start to be established in regard to interprofessional care, collaboration, and standards of care regarding evaluation and treatment for concussion-related vision disorders in order for patients to return to occupation.

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