Profile of Selected Aspects of Visually-Symptomatic Individuals With Acquired Brain Injury
A Retrospective Study

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Abstract
We reviewed the records of 220 visually symptomatic, ambulatory patients with acquired brain injury. These patients were examined at the State University of New York, State College of Optometry's Raymond J. Greenwald Rehabilitation Center (RJGRC). The records were divided into sub-groups of mild traumatic brain injury (TBI) and cerebral vascular accident (CVA). The former group accounted for 160 patients and the latter 60 patients. They were profiled with respect to: patient demographics, referral sources, frequency of multiple TBIs, past/concurrent rehabilitative therapies, presenting spectacle lens types, vestibular symptoms, vision symptoms, and medical histories. Patients in both sub-groups were primarily referred to the RJGRC by the departments of rehabilitation medicine in local hospitals. Physical therapy was the most frequently reported either previous or current therapy. Single vision spectacle lenses were most common to both. Over 55% of each sub-group reported loss of balance as their primary vestibular symptom. Eyestrain at near was the most frequently reported vision symptom in the TBI sub-group, whereas blur at near was most frequently reported for the CVA sub-group. Joint pain was the most frequently reported medical symptom in TBI, and numbness/weakness of extremities was the most reported for CVA. Obtaining a profile of various aspects of TBI and CVA patients can alert the clinician to various conditions and aspects that are characteristic of these patients to assist in case management.

Key Words
acquired brain injury, cerebral vascular accident, demographics, medical history, referral sources, rehabilitation, spectacle lens types, traumatic brain injury, vestibular symptoms, vision symptoms

Introduction
Acquired brain injury (ABI) is an umbrella term including such diverse conditions as traumatic brain injury (TBI), cerebral vascular accident (CVA), non-specific vestibular dysfunctions, and post-surgical complications.[1] Individuals with ABI often report multiple vision and vestibular symptoms,[2-10] as well as cognitive and physical limitations.[1] Knowledge of the most commonly reported symptoms will assist in the patient's overall optometric care and management. In addition, other aspects of the typical TBI or CVA patient are important, such as past and current medical conditions and rehabilitation regimens, as they may impact on the vision treatment plan.

Only a few studies have been conducted delineating these patients' vision symptoms and signs.[5-8] However, sample sizes were small, not all patients were symptomatic, emphasis was on the vision signs and not the associated symptoms, and CVA was not specifically addressed. Only one study specifically addressed patient symptomatology.[8] In this study, symptoms in 16 patients with mild TBI included blur, diplopia, headaches, light sensitivity, dizziness, and reading problems.

The purpose of the present investigation was to profile retrospectively several aspects of TBI and CVA sample populations. These aspects included: age, gender, years post-injury, frequency of multiple TBI, referral source, past/current therapies, presenting type of spectacle lenses, vestibular symptoms, vision symptoms, and medical history.

Methods
A computer search was conducted of all visually symptomatic, ambulatory patients who were examined at the Raymond J. Greenwald Rehabilitation Center (RJGRC), located at the State University of New York, State College of Optometry, from 10/01/2000 to 10/07/2003. This query searched for those records with the procedure codes 99203 (new patient encounter) or 99213 (established patient encounter). The search yielded 486 records. Three of the authors reviewed 300 of these records that were randomly chosen. Only the records of those patients with either mild TBI (n=160) or CVA (n=60) were included. Its purpose was to profile selected aspects of these patients. Table 1 lists the areas we elected to study (left column), along with the specifics we found for each area (right column).

We chose to review only the initial vision evaluation encounters of the subjects. These included refractive assessment (at distance and near), binocular sensorimotor assessment (at distance and near), clinical oculomotor assessment, color vision assessment when indicated, ocular health assessment that included biomicroscopy, applanation tonometry, dilated fundus examination (as deemed appropri-

Table 1. Summary of Most Frequently-Reported Data in the Case History

Demographics	• For TBI and CVA: ○ Age range ○ Mean age ○ Gender ○ Range of years post-injury at initial presentation ○ Mean number of years post-injury at initial presentation ○ Number of subjects with multiple TBI (for TBI only)
Referral source	• Hospital rehabilitation medicine department • Internal referral from the University's primary care clinic • Non-hospital rehabilitation center • Private physician • Private optometrist
Types of rehabilitation	• Physical therapy • Occupational therapy • Speech therapy • Cognitive therapy • Psychosocial therapy
Presenting lens types	• None • Contacts • Single vision • Bifocal • Multifocal • Prism
Vestibular symptoms	• Loss of balance • Vertigo • Dizziness • Motion sickness
Vision symptoms	• Distance vision blur • Near vision blur • Eyestrain with near vision tasks • Headaches with near vision tasks • Loses place when reading • Increased light sensitivity
Medical history	• Numbness/weakness • Muscle aches/joint pain • History of depression • Gastrointestinal dysfunction • Cardiovascular problems

ate), and visual field assessment. In some instances, all areas could not be evaluated due to limitations in the patient's cognitive status, language ability, and/or physical state.

Referral sources for the RJGRC patient population included the following greater metro New York medical institutions: RUSK Institute of Rehabilitation Medicine at New York University (NYU) Medical Center, Bellevue Hospital at NYU Medical Center, Mount Sinai Medical Center's Department of Rehabilitation Medicine, Lenox Hill Hospital, New York Hospital, and the International Center for the Disabled. Additional referrals to the unit were also received from other services within the college's University Optometric Center (UOC) including Primary Care, Low Vision, Contact Lens, Ocular Disease and Special Testing services, as well as outside health care practitioners.

Results

Table 2 presents several demographic aspects of the sample at the initial encounter. The mean age and range were biased towards the older side in the CVA sub-group as opposed to the TBI sample. The gender distribution was similar in each sub-group. While the range of years post-injury was considerably different between the sub-groups, the mean number of years was not. Approximately one-third of the TBI sub-group had more than one episode of injury.

Table 2. Patient Profile Based Upon Initial Presentation at the RJGRC

Parameter	TBI (n=160)	CVA (n=60)
Age range (years)	8 to 91	24 to 90
Mean age (years)	44.9	61.2
Number of males	73	33
Number of females	87	27
Years post-injury (range)	0.1-42.0	0.1-18
Mean years post-injury	4.5	2.7
Number with multiple TBI	52	N/A

Table 3. Referral Sources

TBI	CVA
Hospital rehabilitation medicine department (47.5%)	Hospital rehabilitation medicine department (46.7%)
Internal referral from the UOC's primary care clinic (17.5%)	Internal referral from the UOC's primary care clinic (16.7%)
Non-hospital rehabilitation center (10%)	Non-hospital rehabilitation center (10%)
Private physician (9.4%)	Private physician (6.7%)/ Private optometrist (6.7%)

Table 4. Previous or Concurrent Rehabilitation

TBI	CVA
Physical therapy (57.5%)	Physical therapy (75%)
Cognitive therapy (36.9%)	Occupational therapy (60.0%)
Occupational therapy (28.8%)	Speech therapy (43.3%)
Speech/psychosocial therapy (22.5%/22.5%)	Cognitive therapy (25%)

Table 3 presents the most common referral sources to the RJGRC that were shared by the two sub-groups. These included: referrals from hospital rehabilitation medicine departments, the UOC's internal clinics, non-hospital rehabilitation centers, and private physicians. Private optometrist's referrals were also included in the CVA sub-group.

Table 4 presents the four most common past/current forms of rehabilitation. Physical therapy was the most common in both sub-groups. Occupational, cognitive, and speech therapy were common to both sub-groups. Psychosocial therapy was unique to TBI sample.

Table 5 presents the most common types of lenses worn at the initial visit. Since some patients presented in multiple categories (i.e., wearing single vision distance glasses as well as single vision reading glasses), the total number for all categories of spectacle lenses in Table 5 for each sub-group does not add up to 100%. Single vision distance correction, single vision near correction, and bifocal cor-

Table 5. Spectacle Lens Types at the Initial Encounter

Spectacle Lens Type	TBI	CVA
None	47/160 (29.4%)	7/60 (11.7%)
Contact lens	8/160 (5 %)	1/60 (1.7%)
Single vision distance	45/160 (28.8%)	13/60 (21.7%)
Single vision near	35/160 (21.9%)	19/60 (31.7%)
Flat-top bifocal	19/160 (11.9%)	13/60 (21.7%)
Multifocal (progressive or tri-focal)	22/160 (13.8%)	12/60 (20.0 %)
Prism (either yoked or fusional)	7/160 (4.4%)	2/60 (3.3 %)

Table 6. Visual-Vestibular Symptoms

TBI	CVA
Loss of balance (58.1%)	Loss of balance (55%)
Dizziness (56.3%)	Dizziness (31.7%)
Vertigo (28.1%)	Vertigo (15%)
Motion sickness (7.5%)	Motion sickness (1.7%)

Table 7. Vision Symptoms

TBI	CVA
Eyestrain with near vision tasks (51.9%)	Near vision blur (40%)
Increased light sensitivity (49.4%)	Eyestrain with near vision tasks (38.3%)
Headaches with near vision tasks (44.4%)	Loses place when reading (33.3%)
Near vision blur (43.8%)	Distance vision blur (31.7%)

Table 8. Medical History

TBI	CVA
Muscle aches/joint pain (47.5%)	Numbness/ weakness (55.0%)
Numbness/weakness (44.0%)	Hypertension (51.7%)
History of depression (40.0%)	Muscle aches/joint pain (36.7%)
Gastrointestinal dysfunction (26.3%)	Cardiovascular problems (31.7%)

rection were common to both sub-groups. Entering with no previous prescription was most common in the TBI sub-group, while entering with single vision reading glasses was most frequent in the CVA sub-group.

Table 6 presents the vestibular symptoms that were reported. Loss of balance was the most common symptom in both sub-groups. Dizziness (the sensation of light-headedness), vertigo (the sensation that either the environment or the individual is moving), and motion sickness were the next most common symptoms in both sub-groups.

Table 7 presents the most common vision symptoms reported. Near vision symptoms were the most common to both sub-groups. Loss of place when reading was unique to the CVA sample, whereas increased light sensitivity and frequent headaches with near vision tasks was unique to the TBI sample.

Table 8 presents the four most common medical signs and symptoms reported by the patients. Numbness and weakness in the extremities, as well as muscle aches and joint pain, were common to both sub-groups. A history of depression and a history of gastrointestinal dysfunction were unique to the TBI sub-group, whereas hypertension and cardiovascular problems were unique to the CVA sub-group.

Discussion

The purpose of this study was to profile characteristics and aspects of a visually-symptomatic, ambulatory patient sample with either mild TBI or CVA who were examined at our university-based, optometric specialty clinic. Table 3 shows that the referrals were primarily from the departments of rehabilitation at local hospitals. These referrals accounted for approximately 47% of each of the sub-groups. Some 10% of the referrals from each sub-group came from non-hospital based rehabilitation centers. Such referral sources would indicate that these patients had received general medical and rehabilitative (physiatric) assessments, and appropriate treatment regimens. The next most numerous referral came from the UOC's primary care clinic; this source accounted for approximately 17% for each sub-group. The relatively low referral rates from private physicians and optometrists give an indication that the most fruitful sources of referral for optometric care of ABI patients are in institutionally based facilities.

Table 4 shows the types of either previous or current therapies received by our patients. These were: physical, occupational, speech, cognitive, and/or psychosocial therapies. All of these involve visually based rehabilitative techniques. Consequently, the more visually symptomatic a patient is, the more difficult therapy may be to administer, and the slower the progress.[11-17] This could account for the robust percentages in each type of therapy that our subjects had previously undergone or in which they were currently engaged; it might well have been that the reason for referrals to the RJGRC were because of the lack of progress in that type of rehabilitative therapy. It is noteworthy that the discipline that had provided or was providing the greatest percentage of therapy in each sub-group was physical therapy. This is probably a function of the significant number of vestibular symptoms reported by our sample as shown in Table 6. Physical therapy is a primary provider for vestibular therapy that is sometimes combined with optometric vision therapy.[18,19]

Near vision blur and eye strain with near vision tasks were common symptoms for each sub-group. Distance vision blur accounted for almost 32% of symptoms in the CVA sub-group, and in both sub-groups near vision blur was reported by at least 40% of the subjects. See Table 7. All of these symptoms were present in spite of a substantial percentage of both groups presenting with either single vision near, and/or bifocal, and/or multifocal lenses. See Table 5. This indicates the need for careful refractive analyses of these patients. The symptom of increased light sensitivity was found in almost 50% of the TBI sub-group. There is evidence that tinted lenses can alleviate this condition.[14,20-22] It is noteworthy that none of the present study's subjects had tinted lenses at the initial evaluation.

A number of the vision symptoms shown in Table 7 could have been caused by oculomotor dysfunctions. Indeed, in a previous report of the same sample, there was an occurrence at greater than 87% in each of the sub-groups in the cumulative categories of accommodation, version, vergence inadequacies, strabismus, and cranial nerve palsy.[23] In a more recent study of these same subjects, optometric vision therapy was prescribed and completed for 33 in the TBI sub-group and seven in the CVA sub-group. The criteria for success

was marked improvement in at least one primary symptom and at least one primary sign. Success of the therapy was 90% in the 33 TBI subjects and 100% in the 11 with CVA.[24] These results provide strong indication that optometric vision therapy should be considered for these patients.

Virtually all of the symptoms relating to their medical history (Table 8) have been reported for TBI[25] and CVA[26] elsewhere. The physical problems such as numbness and weakness, and muscle aches and joint pains for both sub-groups, can indicate that special physical accommodations might be necessary during the optometric evaluation. A history of depression was found in 40% of the TBI sub-group, but was absent in the CVA sub-group. However, it has been reported as a characteristic condition in both groups.[25,26]

There were several commonalities in profile between the TBI and CVA sub-groups in the sample: predominant referral came from departments of rehabilitation medicine; physical therapy was the most common form of previous and current therapy; loss of balance was the primary vestibular symptom, and single vision spectacle lenses were most prevalent. The major distinctions between the two sub-groups were in the older mean and median ages, and in the reported hypertension and cardio-vascular histories in the CVA group. These differences have been documented elsewhere.[27] A further difference was the greater percentage of the TBI sub-group who had presented without spectacles. This could be a product of the age difference between the sub-groups.

Delineating the characteristics of such a specialized clinic's sample population provides insight and direction for these individuals' evaluations and managements. The present study has provided some new information in this regard. The data suggest some further investigations that can be useful in the planning for the emerging involvement of optometric care in the ABI population. For example, the patients of this study were examined at an institutionally-based, optometric specialty clinic. A smiliar study of patients receiving care in non-institutionalized settings could provide further information. Also, in the present study, while the number of patients wearing refractive correction at the initial visit only was reported, it would have been beneficial to determine the number of patients requiring a correction at the first visit, as well as those being altered or no longer required at later visits. A future study may investigate the results of the diagnoses and proposed management interventions for those with ABI.

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