OCULAR MOTILITY DISORDERS FOLLOWING HEAD INJURY

R. MITCHELL MSc (Macq), MEd (Syd), DipAppSc (Cumb), DOBA
Department of Behavioural and General Studies, Cumberland College of Health Sciences

A. MACFARLANE DOBA
Lidcombe Hospital

E. CORNELL DipAppSc (Cumb), DOBA
School of Orthoptics, Cumberland College of Health Sciences

Abstract

Little has been written in the literature regarding the incidence of ocular disorders in patients with head injuries. This paper attempts to remedy this deficiency by comparing a population of hospitalised patients in a head injuries ward with a series of patients who have suffered head injury and subsequently been referred for orthoptic treatment and/or assessment. It is concluded that there exists sufficient evidence to support an argument for the introduction of routine ocular motility assessment of all patients who have suffered head trauma.

INTRODUCTION

Generally reports in the literature of examinations of ocular movements are concerned with the neurological function of determining whether there has been a supra-nuclear lesion or an infra-nuclear lesion of the 3rd, 4th or 6th cranial nerves. Belleza *et al.*[1] compare seven normal with twenty brain damaged patients with drawing impairment on the Bender Visual-Motor Test. All patients showed eye movements and fixation patterns different from the normals and they concluded that impaired motor responses may confound interpretations about visual cognitive impairment.

Borouski and Matkus,[2] Roper-Hall,[3] and Holmes[4] all deal with blindness induced by closed head trauma.

Baron *et al.*[5] stress the influence of the mesencephalic oculomotor system on orthostatic regulation. They describe an instrument useful for recording displacement of the body's centre of gravity with respect to the centre of basis.

Sen[6] reports on paradoxical eye movements for two cases, one acquired following head injuries. This case presented with a ptosis and an absence of elevation. Hartje *et al.*[7] stress the value of ocular movements in screening for organic cerebral dysfunction; they do not maintain the value in trauma induced dysfunction. Nystagmus was found to be the most common symptom following head injury in a sample of 100 subjects described by Meran *et al.*[8] Miretskaia[9] discusses the state of tonic convergence in closed brain injury for one subject.

Van Zomeren and Deelman[10] examined long-term recovery of visual reaction time after closed head injury. A large sample (n = 57) was employed and reaction time discriminated between subgroups formed on the basis of length of unconsciousness after injury.

Based on a sample of size one Young *et al.*[11] showed that a colour vision defect can follow an occipital area blow. The sample in this study is too small from which to generalise.

Cowey and Porter[12] working with monkeys demonstrated a loss in global stereopsis following brain damage. They suggest that this ability may be selectively impaired following brain damage in man.

Stanworth[13] presents a series of eleven patients chosen specifically for their complete loss of fusion following head injury. In this series all patients presented with diplopia and loss of fusion. One patient had received his head injury as a result of a motor cycle accident, six had been in motor vehicle accidents, one a mining accident, and another a blow to the head. The cause of injury in the other two patients is not given.

Field loss was reported in only one of Stanworth's[13] series. Two patients presented with nystagmus, one with a convergence weakness and eight were reported to have heterotropias. Of these eight deviations two were known to have existed prior to the head injury. Two patients ultimately developed multiple sclerosis and it is suggested that "head trauma may precipitate the ocular signs of disseminated sclerosis" (Stanworth, 1974, p. 270).[13]

Waddy[14] analyzed the injuries to 32 eyes of 30 children who survived motor vehicle accidents (MVA's). She found that each child was unrestrained and that the resulting "eye injuries are disastrous". (Waddy 1981, p. 119).[14]

All of the above articles present some aspect of ocular disorders which may follow head injury. No study has as yet been undertaken to examine the incidence of ocular disorders in a series of head injured patients.

It was proposed to examine a population of patients who have had head injuries in an attempt to ascertain the incidence and nature of ocular disorders in such a population.

METHOD

A checklist was designed which enabled data to be gathered on the following variables; age, sex, pre-existing medical history relevant to ocular disturbance (e.g. diabetes), cause of head injury, duration, communication ability, previous ocular history, major ocular symptoms (if any), presence or absence of a ptosis, presence and type of nystagmus, presence and type of abnormal head posture (i.e. ocular or non-ocular), pupillary responses, visual acuity right and left, near and distant, presence and type of strabismus, convergence, saccades, colour vision, stereopsis, accommodation, ocular movements and visual fields.

The population examined in this study consisted of all patients in or admitted to a head injury ward in a large metropolitan hospital over the period January to September 1982. To obtain more recent comparative data than that given by Stanworth[13] a retrospective search of all patients from this ward, referred to the Eye Clinic in this hospital, for the period 1975 to December 1981, was undertaken. Patients resident in the ward in January 1982 were included in the population and not in the retrospective group.

TABLE 1
Sex and Age of Sample

Variable		Group	
		Retrospective group	Target population
Males		12	16
Females		6	5
Mean age		30.6 years	23.8 years
Standard deviation	(age)	12.7 years	6.2 years
Age range		16-56 years	15-45 years

RESULTS AND DISCUSSION

A total of 39 subjects were examined in this study, 18 from the retrospective group (RG) and 21 from the target population (TP). Sex distribution and age at presentation statistics are presented in Table 1.

Clearly there exists a predominance of males (71.8%) with the ratio of male to female being two to one in the RG and just over three to one in the TP.

There exists a substantial discrepancy, 6.8 years, between the two groups. Also the RG has a much greater age range than the TP. The above needs to be considered in the context of other demographic data, specifically cause. Table 2 compares the two groups by cause of head injury.

TABLE 2
Cause of Head Trauma

Cause	Group	
	RG	TP
Motor vehicle accident	7	17
Motor cycle accident	2	2
Assault	0	2
Fall	1	0
Other	8	0

The majority (71.8%) of subjects had been involved in a motor vehicle accident (MVA), or motor cycle accident. Of these 28 subjects, five out of nine were males in the RG and 14 out of 19 in the TP group were males. It is known that in MVA's the majority of drivers are males under the age of 25 years, and it is felt that the predominance of traffic accident patients in the TP gives such a large number of males and the smaller mean age for this group.

TABLE 3
Time Interval Between Onset of Trauma and First Seen for Eyes

Time interval	RG	TP
Less than one month	0	2
One month-three months	3	1
Three months-six months	0	1
Six months-one year	1	5
One year-1½ years	1	4
1½ years-2 years	3	1
2 years-3 years	5	4
More than 3 years	5	3

As would be expected the date of onset of trauma (Table 3), was much more recent for the majority of subjects in the TP group. Of the total sample 27 (69%) had no prior ocular history, in five cases it was unknown if they had previous history, one person in the TP had been treated for a viral infection, and one treated for a convergence insufficiency. A total of six had had treatment other than for cataracts, glaucoma, retinal problems, squint, trauma, and viral infections. It was unknown in four cases whether or not they had been on ocular medication, the remainder, 35 (90%), had not been on any ocular medication.

Only one person in the TP and six in the RG had worn or were wearing glasses at the time of being first seen.

Table 4 presents the ocular symptoms as stated by the subject. Only the principal symptom was noted, and if more than one symptom was giving distress, this was recorded as a combination. It was impossible to ascertain symptoms from one patient in the TP due to her extreme aphasia.

TABLE 4
Major Ocular Symptom

Symptom	RG	TP
Blurred vision	1	4
Sore eyes	0	1
Diplopia	11	6
Unable to read	0	1
Field loss	1	3
Diplopia and blur	5	3
Unknown	0	1

As one would expect, all patients in RG presented with some ocular symptoms since they had presented or had been referred to any eye clinic for treatment. Nineteen of the twenty-one patients seen in the TP had an ocular symptom. The principal symptom experienced was diplopia (17/39), or, including diplopia and blur (25/39).

Pupillary responses were measured in both eyes to direct, consensual and near stimuli. Data gathered has been collapsed and is presented in Table 5 below. A total of 29/39 patients had normal pupil responses to the above three stimuli.

TABLE 5
Pupillary Responses

Response	RG	TP
No apparent defect	15	14
Defective	—	5
Unassessable	—	1
Unknown	3	1

One patient in the TP was unassessable (unilateral enucleation) and one unknown (discharged from hospital before testing completed). No generalisations can be made from the five patients who had defective pupillary responses, other than to state that three had defective pupillary responses with a third nerve palsy, one had a defective pupillary response consistent with optic nerve damage and one had an inexplicable defective response.

Visual acuity of all patients in both groups was sought. All of the RG used Snellen's linear charts, nine eyes had reduced VA at 6 m and 17 reduced near VA.

It was possible to do a VA on all patients in the TP, 19 of the group used Snellen's linear charts, one Snellen's single letters and another Sheridan Gardiner single letters. Only three showed an abnormal reading technique, all three being field losses. Distance (6 m) VA ranged from 6/5, to hand movements in right eyes and 6/5 to blind in left eyes. Visual acuity for 6 metres in this group is given below.

TABLE 6
Visual Acuity Six Metres

Vision	Right eye		Left eye	
	TP	RG	TP	RG
6/6 or better	7	15	8	12
6/12-6/9	9	3	6	6
6/36-6/18	1		4	
6/60 or worse	4		1	
Blind	0		1	
Unknown	0		1	

There is one unknown response for a left eye of one patient. On the first occasion of testing the patient fatigued before testing could be completed. On the second occasion the patient had been discharged.

TABLE 7
Visual Acuity 33 cm

Vision	Right eye		Left eye	
	TP	RG	TP	RG
N5	6	10	8	9
N6	4	5	3	7
N8	3	3	3	2
N10	4		2	
N14	3		3	
Blind	0		1	
Unknown	1		1	

Over half the group have a reduced visual acuity at 6 m (i.e. less than 6/6 R and L). Similar findings were obtained for VA at 33 cm (see Table 7).

An assessment of the presence/absence of strabismus was undertaken using the cover test at 33 cm and 6 m and an accommodative target, in the case of the TP.

Results of cover testing for the RG were taken from records. The results are given below in Table 8.

TABLE 8
Strabismus

Type of deviation	RG	TP
No apparent deviation	2	4
Heterotropia (const.)	11	12
Heterotropia (inter.)	0	1
Heterophoria (33 cm)	5	2
Heterophoria (6 m)	0	0
Heterophoria (33 cm and 6 m)	0	1
Unassessable	0	1

Frequencies between the two groups are quite comparable over the various categories of deviation employed. It is of note that the majority of cases (23/39) had a constant strabismus. The unassessable patient in the TP was the patient who had had his left eye removed.

Consideration of the 23 patients who had heterotropias resulted in two (one from each group) as having had the squint prior to injury, two (one person each group) being due to mechanical injury, one in the TP was unassessable and the aetiology of the third in the RG were unknown. The remaining 15 were nerve palsies induced by the trauma, the breakdown of which is given below in Table 9.

TABLE 9
Nerve Palsies

Nerve	RG	TP
III	1	2
IV	3	5
VI	1	1
Combination	1	1

As would be expected, the highest incidence in both groups is a palsy associated with cranial nerve IV. The combined palsies were both partial cranial nerve III with a unilateral palsy of cranial nerve VI. It is of interest that there exists 33% more palsies in the TP, even though the number of heterotropias in both groups are almost equal.

An assessment of convergence using the RAF near point rule, was carried out on all patients in the TP. The results are presented in Table 10.

Just over half the TP had defective convergence (i.e. convergence near point as measured by the RAF rule greater than 5 cm). This relates to ocular symptoms (Table 4) in that defective convergence may well be a contributory factor to many of the patients' symptoms.

Saccades were observed and saccadic velocities estimated in all patients in the TP. Ten of the group had abnormal saccades, of whom three had abnormal horizontal movements, two had abnormal vertical movements and five had abnormality of both horizontal and vertical movements. Of these 10 all but one had a manifest strabismus and of these six were nerve palsies. Thus, of the nine identified nerve palsies in this group six had defects of saccadic movements. In addition the patient with the mechanical restriction, as would be expected, also had defective saccades.

TABLE 10
Convergence Near-point (RAF) in Centimetres

Near-point	RG	TP
Full (0-5 cm)	8	10
5 cm-10 cm	1	3
10 cm-15 cm	2	1
15+cm	1	2
Total absence	1	4
Unassessable	—	1

Only four patients in the TP were deemed to have abnormalities of saccadic velocities. Given the number who had defective saccades, this number is much less than would be expected and may well be due to the inexperience of the observer in estimating and assessing these velocities.

For the RG only one patient was recorded as having defective horizontal saccades and one with defective saccadic velocities. The latter patient had a third nerve palsy and the former a heterophoria for near.

Colour vision was assessed, using the Ishihara plates, on all patients in the TP. No assessment was available for the RG. Two patients in the TP had defective colour vision as assessed by this test and one completed the test satisfactorily but his technique indicated a left-sided field defect.

All patients in TP had BSV assessed using the TNO random dot stereo test. It was not possible to elicit any response from eight patients (one of whom was uniocular). Two of these patients were aphasic and were unable to give a meaningful response to the test and of the other five two were amblyopic and three had very large constant squints. It was not determined if these three could achieve the test with prisms neutralising their deviation.

The remainder of the group presented with some degree of BSV, ranging from recognition of the control plates to 60 seconds of arc.

BSV for the majority of patients in the RG was not recorded. Seven had reduced BSV as measured by the Titmus test, one had all grades of BV assessed on the synoptophore and two had no BSV or BV at all. All of the patients where BV or BSV was assessed had a strabismus.

In the TP fourteen patients had normal accommodation for age (both binocularly and monocularly) as assessed by the RAF near-point rule. Three patients had accommodation slightly better than would be expected for their age and four had reduced accommodation (both binocularly and monocularly). Three of the four who had reduced accommodation had heterotropias and presented with diplopia, the fourth patient was orthophoric but presented with blurred vision as her major symptom.

Accommodation was recorded in the case of one patient in the RG. This patient, who presented with diplopia, had a fourth nerve palsy and reduced binocular and monocular accommodation.

Ocular movements were assessed in all patients in the TP. No major pattern emerged other than defects were consistent with paresed or entrapped muscles.

Finally, confrontation fields were assessed in all patients in the TP. Only two patients had defective fields, one a blind left eye and the other a left hemianopic defect i.e. R temporal and L nasal fields were not present.

CONCLUSION

While proving impossible to compare the two groups on all variables defined at the outset, it has been possible to make comparisons on the principal variables of symptoms, visual acuity, strabismus, nerve palsies, and convergence near point.

Head injuries can clearly affect both ocular movement and binocular vision, but treatment of these affectations may not be at the top of list of treatment priority immediately post-trauma. Once the patients have reached the period of recuperation and rehabilitation, ocular assessment and treatment should be an established component of such programmes.

As Mein[15] points out "The role of the orthoptist in the care of patients with head injury is firstly diagnostic, ... and secondly therapeutic". It would prove interesting to examine the effect on rehabilitation of early orthoptic and ophthalmological intervention in a series of head injured patients.

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