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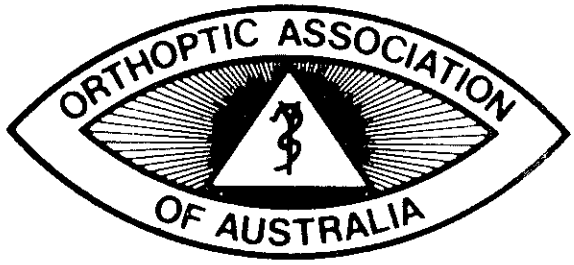
ORTHOPTIC JOURNAL



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CONTENTS

EDITORIAL

Forty years ago the first scientific meeting of The Australian Orthoptic Association was held. Four years later Orwell in his writings was attempting to predict the changes in the quality of life that would occur by 1984. It would have been even more difficult, perhaps, to foresee the progress that would be made in orthoptics in that time.

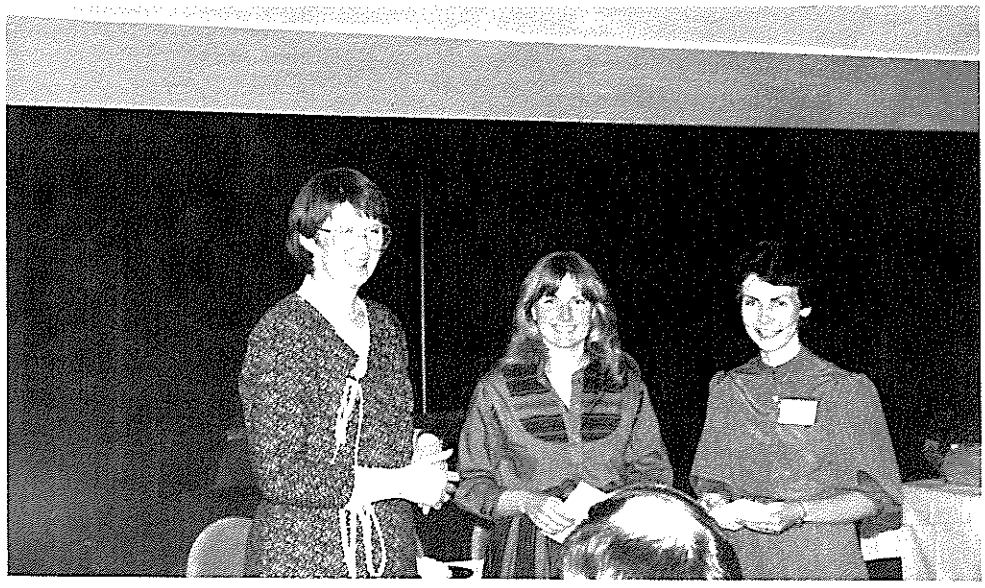
An interesting yardstick by which to measure this progress is the paper, entitled "Observations on Hyperphoria", initially presented by Lucy Retalic at that meeting, forty years ago, and which she was prevailed upon to reread at our last annual conference in Adelaide. I quote:

> "It occurred to the writer that the absence or presence of hyperphoria might be a definite contributory factor to the prognosis of these cases".
>
> "The high percentage of cases in which hyperphoria was present—53% of 200 cases surveyed—was unexpected."
>
> "The presence of suppression and its breaking down was a big factor in reducing or eliminating the hyperphoria."
>
> "The development of binocular vision generally and ductions in particular was another large factor in the successful treatment of this defect."

Ideas which were contained in those early observations have been developed further to-day and where there is obvious contrast it is evidence of the changes that have taken place in diagnostic, management and research methods in keeping with current scientific trends.

One wonders where the next forty years will lead. Shall we be judged on the papers presented in this journal with their emphasis on electrophysiology, community health and neuro-ophthalmology?

Margaret Doyle



Immediate Past President, Miss Jill Stewart (L.), presents co-authors, Mrs Susan Horne (C.) and Miss Cathie Searle (R.), with their award as joint winners of The Emmie Russell Prize for 1983.

SUPPRESSION OF A BLURRED VISUAL INPUT BY NORMAL SUBJECTS CAN BE DEMONSTRATED USING THE VER

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Abstract

Strabismus and anisometropia are generally accompanied by a sensory adaptation in the form of some suppression of the input from the affected eye. In this study identical images of less than 0.5° of visual angle were presented to the two eyes of normal subjects by means of a synoptophore and their positions adjusted until they became fused. A reversing checkerboard stimulus was added to the background field of either eye to obtain a monocular visual evoked response (VER) during binocular viewing of the fused synoptophore image. Defocusing of the synoptophore image to one eye by approximately 2 dioptres reduced (to 50%) the amplitude of the VER from the same eye. Occlusion of the unstimulated eye greatly increased response amplitude and eliminated the effect of defocusing. Most subjects were able to maintain a subjectively clear synoptophore image though the image to one eye was defocussed. The study confirms that under binocular viewing conditions normal subjects can effectively suppress an inferior input to one eye. It is proposed to use a similar technique to explore the suppressing abilities of strabismic and anisometropic subjects.

Key words: *Sensory adaptation, synoptophore, defocussed image.*

INTRODUCTION

When the eyes are normally aligned and able to produce a well focussed retinal image, these similar images are readily 'fused' and are then perceived as one. When the eyes are misaligned as in strabismus or one is affected by a large, uncorrected refractive error as in anisometropia, the retinal images then formed become more dissimilar and thus for the central retina are more difficult to perceive as a single image. Strabismic and anisometropic patients, in order to maximise their visual performance, commonly demonstrate a sensory adaptation to this condition whereby they cease to attend to or 'suppress' the inferior image from the affected eye.

If the eyes of normal subjects are presented with totally dissimilar retinal images (i.e. SP slides) using a haploscopic device the images are not perceptually fused and there appears to be no definite preference for one input over the other, both images finding some representation in consciousness i.e. retinal rivalry. In the present experiments a method is used to investigate the abilities of normal subjects to suppress when confronted with similar images, one of which has been defocussed using artificial lenses to produce a simulated refractive error.

METHOD

Subjects were screened by orthoptists to establish visual acuity and stereopsis.

The synoptophore was modified so that a patient could simultaneously view the reversing checkerboard, placed behind the synoptophore,

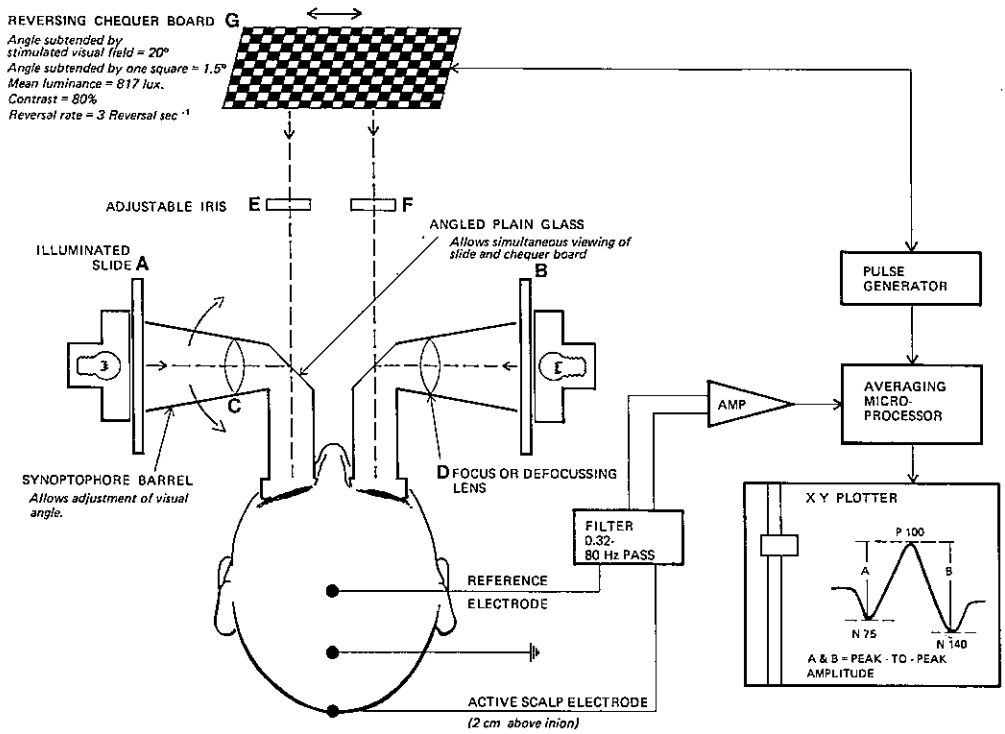

Figure 1: Experimental arrangement.

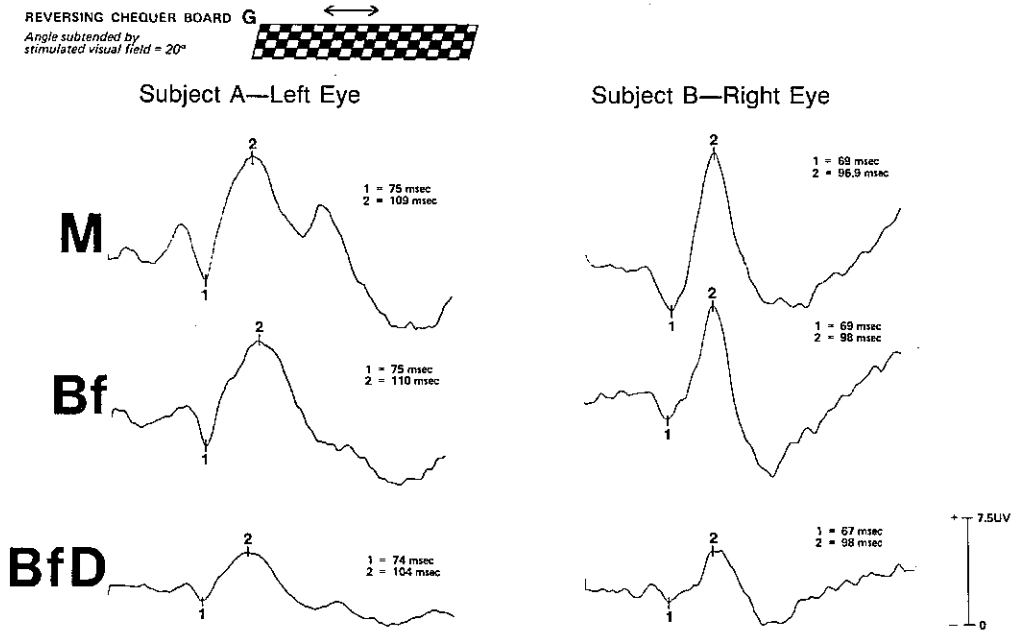

Figure 2: Sample recordings. Calibration refers to all traces.

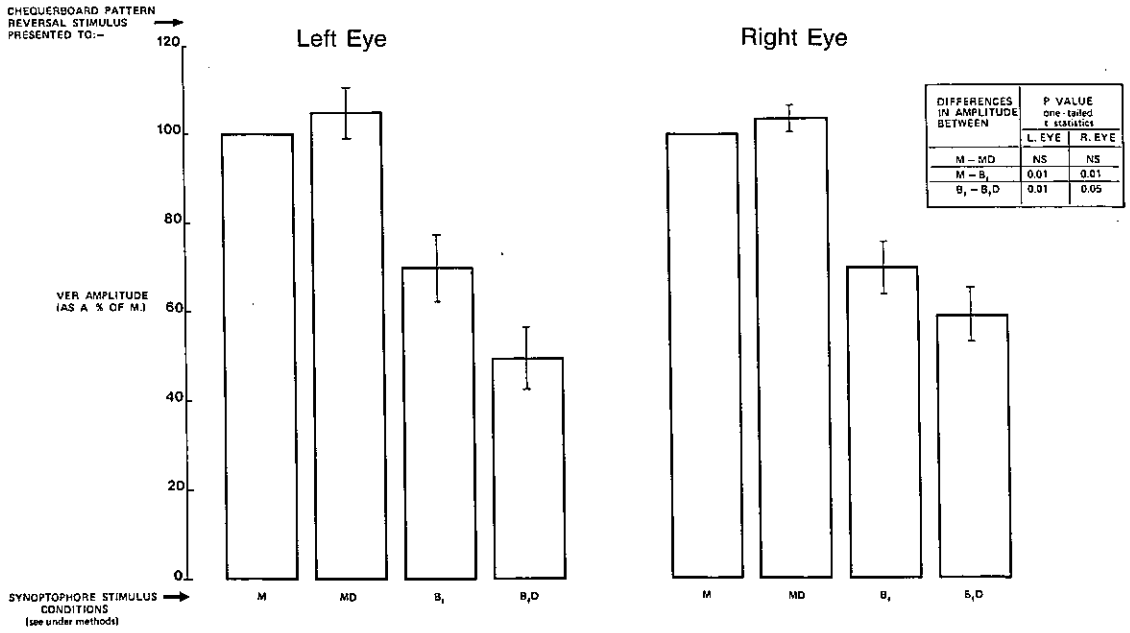

Figure 3: Pooled data ($n = 8$) to show changes in peak to peak amplitude of the VER from the left and right eye under different stimulating conditions listed below. All values are expressed as a percentage of the M (monocular) value for the same eye. The bars indicate standard errors.

and synoptophore fusion slides, which subtended 3°. As well, the convex lenses were removed from their usual position to position C and D (Fig. 1). These lenses could be exchanged to enable an increase in the lens power by 2DS in order to defocus the synoptophore slide, without affecting the checkerboard image clarity. Two adjustable diaphragms were positioned at E and F (Fig. 1), either to enable control of the size of the field of stimulation by the checkerboard to 20° or to occlude one eye to enable monocular tests to be carried out.

The patient was set up for VER assessment with the response to each checkerboard reversal being collected and accumulated, with the end result being determined following the averaging of 128 stimulation-responses.

Separate monocular VERs were recorded from left and right eye under each of the following conditions:

M. (monocular)	Slide presented to the stimulated eye only, the other eye being covered.
M.D. (monocular, defocussed)	As for M except that the synoptophore image was defocussed by increasing the strength of the lens (C, D) by 2 spherical dioptres.
B_f (binocular, fused)	The slides (A and B) were presented to each eye and synoptophore barrels adjusted until the subject was able to fuse the images.
B_fD (binocular, fused, defocussed)	As for B_f except that the image to the stimulated eye only was defocussed at C or D. (See Fig. 2.)

RESULTS

From Fig. 3 it may be observed that:

1. The monocular (m) VER amplitude was greatly reduced by presentation of a synoptophore image to the other eye. (The difference between M and B_f was significant at the 0.01% level).

2. VER amplitudes from the 2 eyes were approximately symmetrical during viewing of the fused synoptophore images (B_f).
3. Defocussing of one of a pair of fused images reduced the amplitude of the VER from the defocussed eye (t values showed BfD to be significantly different to B_f at the 0.01% level for the left eyes and at the 0.05% level for the right eyes).
4. Defocussing the synoptophore image when it was viewed monocularly, could not be seen to have an effect on the VER response.

As a further control under conditions where fusion was prevented by vertical displacement of one of the images the suppression effect was not evident.

CONCLUSION

We conclude that approximately symmetrical responses may be obtained from the eyes of normal subjects under binocular viewing conditions. However, normal subjects also possess the ability to suppress the input from one eye when it is presented with a poorly focussed image in binocular circumstances and this is associated with attenuation of the VER from the suppressed eye. Further this effect is dependent on the fusion of images, one of which is superior in clarity to the other.

This form of suppression is likely to contribute to maximising the binocular visual acuity of patients with unilateral refractive errors under similar conditions but cannot be related to the suppression associated with strabismus where patients are unable to fuse.

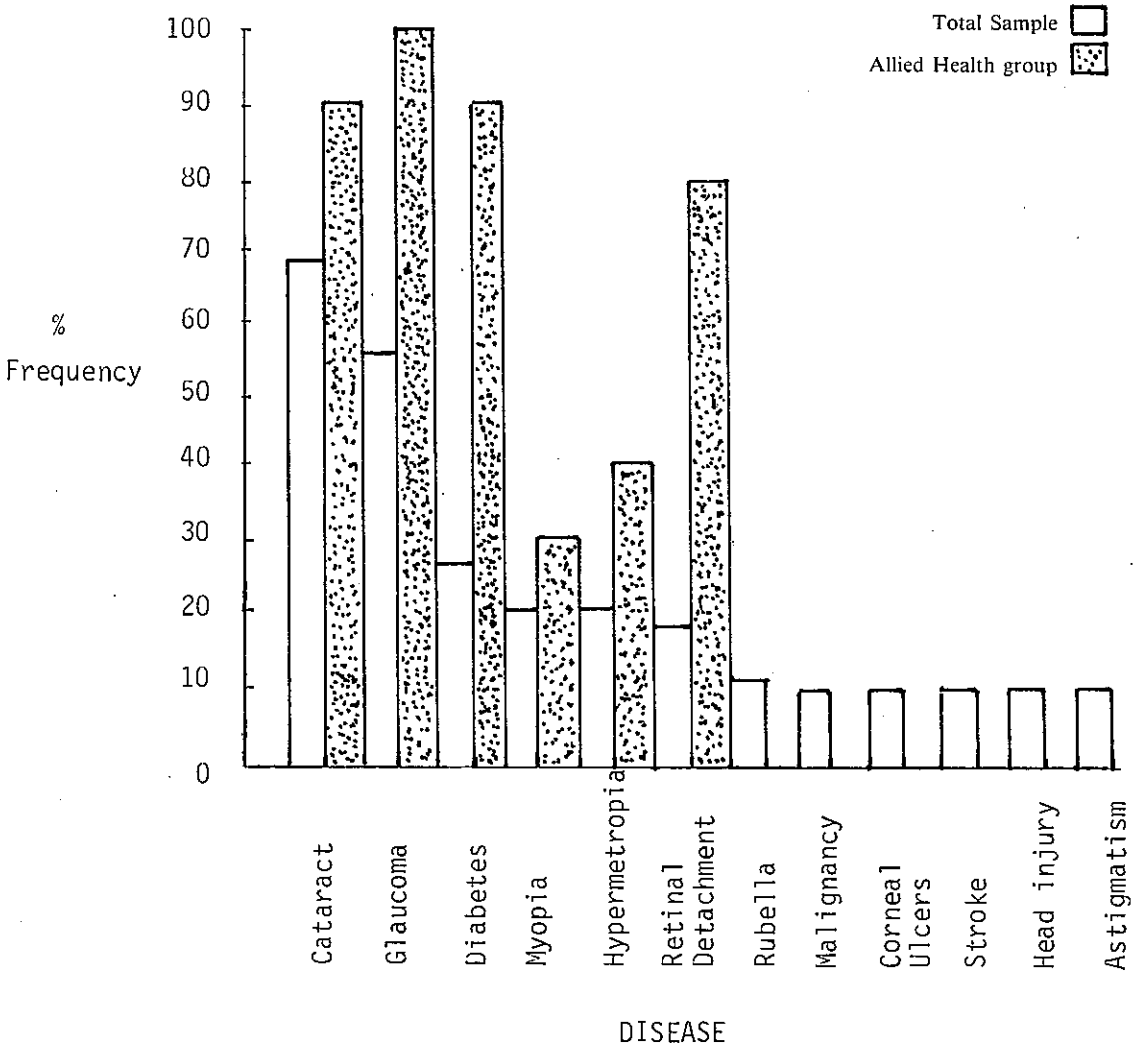

Figure 1: Frequency distribution (percentages) for the ten most frequently mentioned diseases.

Reduced vision is seen to be due, principally, to refractive errors and not to possible medical conditions. Only 44.5% of 45 to 64 year olds seek a medical investigation of their eyes, and it is seen that 46% of those over 64 years of age see non-medical professionals for vision problems.

The above data, the number of legally blind elderly persons being referred to an eye clinic from nursing homes, and the generally held attitude "that vision failure is a normal function of ageing and is to be accepted" prompted the author to investigate commonly held knowledge about vision and eye care in the community at large.

METHOD

A self administered questionnaire containing forced-choice and open-ended questions was administered to 264 persons.

The ages of the sample employed in this study ranged from 25 years of age up, with a mean of 40.1 years. There were 50 persons in this sample who could be classified as health or health-related workers.

VISION IN THE ELDERLY—A NEED FOR PUBLIC AWARENESS?

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Abstract

It is contended that visual decline in the elderly is considered to be due to first acceptance of this as part of the "elderly" role and second due to public and professional ignorance. This contention is supported by the responses of 264 persons to a forced-choice and open-ended questionnaire.

Knowledge is compared between non allied health and allied health groups and while most are aware of some ocular diseases associated with aging little was known about senile macular degeneration.

There exists a definite role for the orthoptist in educating the public about change in visual status associated with aging and the need for early and regular ophthalmological assessment.

Where loss of vision is medically diagnosed as inevitable there is a need for the establishment of an Australia-wide counselling service.

Finally the orthoptist can play a valuable role in the visual screening of adults and in educating allied health personnel to the changes in vision associated with aging.

Key words: *Knowledge of common eye problems, macular degeneration, early and regular assessment, orthoptist role.*

The February-May, 1979, publication by the Australian Bureau of Statistics (ABS)[1] states that 85.78% of persons 45 to 64 years of age and 96.31% of persons 65 years of age and over have a loss of sight. This publication also presents data on the incidence of persons with a loss of sight which cannot be helped by the use of glasses/contact lenses:

(i) there are 13.45% in the age group 45 to 64 years of age (2.40% bilateral and 11.05% unilateral)
(ii) there are 14.88% in the age group 65 and over (4.25 bilateral and 10.63% unilateral).

No data is available as to the reasons why these people are unable to be assisted by refractive correction, however, the question which must be asked is to what extent could these figures be reduced by early intervention and preventive measures?

Further, even if vision is helped by use of the appropriate refractive correction, data presented by Martinez *et al*[2] indicates for 65 years of age and over that 19% of males and 31.2% of females will still have a visual acuity of 6/12 or less. Refraction, then, is still not the complete answer to decline in vision in this age group.

Second, the data relating to persons who had their sight tested in the last five years (p. 20)[1] can be collapsed, as given in Table 1 below.

TABLE 1
Percentage of persons who had their sight tested in the last five years

Time since last sight test	Age (years)	
	45-64	65 or more
Less than 1 year	38%	37%
1 year to less than 3 years	41%	37%
3 years to 5 years	21%	26%
Persons who tested sight		
Eye specialist/Ophthalmologist	40%	46%
Optometrist/Optician	54%	46%
Other person (G.P., nurses)	4.5%	7%
Not known	1.5%	1%

Frequency counts for each question were obtained and comparisons between health workers and non-health workers are presented.

RESULTS

To the question "Do you feel that some loss of vision is inevitable as a normal part of aging changes?" 2.3% (6) did not respond, 6.8% (18) said no, 18.2% (48) were unsure and the remainder 72.7% (192) said yes. In the health professional group 90% (45) said yes and 10% (5) were uncertain.

Respondents were asked to list any complaints which can cause a decrease in vision at any age.

The diseases most frequently mentioned by both the total sample and the allied health group are given in Figure 1.

TABLE 2
Those complaints stated to be associated with aging

Total Sample		Allied Health Group	
Complaint	Frequency (%)	Complaint	Frequency (%)
Cataract	32	Glaucoma	50
Glaucoma	30	Cataract	40
Diabetes	11	Diabetes	30
Stroke	7	Hypermetropia	20
Senility	7	Hypertension	20
Hypermetropia	7	Presbyopia	10

In the allied health group myopia, strabismus, hypertension and presbyopia had equal frequency of occurrence but only the first mentioned in this list occurred in the ratings for the total sample. Herpes and ptosis were next in frequency, then retinal degeneration, with the others not being mentioned. Other diseases mentioned by the allied health group were congenital defects, ocular muscle palsy, corneal ulcers, pterygium, retinitis pigmentosa, trachoma and retrolental fibroplasia.

Apart from cataracts and glaucoma less than 50% of the total sample were able to identify any other diseases. The allied health group were only able to name four diseases, cataracts, glaucoma, diabetes and retinal detachment at better than 50% response rate.

Subjects were asked to identify those complaints that are specifically associated with aging.

Table 2 lists all complaints associated with aging identified by the two groups. There exists a different listing for each group.

Respondents were next presented with a list of twenty complaints and asked to place a tick beside the complaint if they had heard of it. Table 3 lists these twenty complaints and the percentage of the total group who had heard of each and in parentheses the percentage for the allied health group.

In general there exists a high prevalence of "having heard" of the specific complaints. Specific areas of deficiency exist with arcus senilis, entropion, presbyopia, temporal arteritis, ectropion, blocked nasolacrymal duct, retinal vascular occlusion. Ignorance about these complaints may be due to the use of appropriate medical terminology. For the allied health group the problem areas were arcus senilis, entropion, presbyopia and ectropion.

"Having heard of a complaint" does not indicate having a measurable knowledge about that complaint. An initial investigation into knowledge was carried out on the above twenty complaints—respondents being asked to place a

TABLE 3
Percentage of Respondents who had Heard of a Stated Disease

Ptotis	34 (100)	Cataract	100 (100)
Glaucoma	100 (100)	Retinal degeneration	70 (90)
Hypertension	98 (100)	Diabetes	98 (100)
Hyperthyroidism	66 (100)	Malignancy	88 (100)
Arcus senilis	9 (20)	Presbyopia	18 (50)
Retinal detachment	89 (100)	Temporal arteritis	32 (90)
Rheumatoid arthritis	100 (100)	Ectropion	11 (40)
Corneal ulceration	66 (100)	Blocked nasolacrimal duct	39 (80)
Entropion	9 (50)	Retinal vascular occlusion	30 (70)
Herpes zoster	55 (100)	Keratitis	32 (90)

TABLE 4
Percentage of those who said Complaint was Preventable

Glaucoma	25 (2)	Corneal ulcers	23 (20)
Hypertension	50 (70)	Herpes zoster	7 (0)
Hyperthyroidism	25 (30)	Cataract	2 (0)
Arcus senilis	2 (0)	Diabetes	14 (10)
Retinal detachment	11 (0)	Malignancy	2 (10)
Rheumatoid arthritis	2 (0)	Nasolacrymal duct	9 (0)

"P" beside the complaint if they knew if it could be prevented. For the twenty complaints listed the total sample stated twelve to be preventable and the allied health group six. The results are given in Table 4.

In many instances the results in Table 4 may reflect some confusion between terms such as prevention, treatable, cure. Some respondents may have equated treatable with preventable. It is doubtful if any of the twenty complaints are preventable.

Finally fourteen specific eye complaints were listed in a table. For each complaint one or more of six alternatives could be chosen to the direction "If you think a treatment is appropriate for the complaint tick the appropriate column". The alternatives were—uncertain, glasses, drugs, surgery, other and not treatable. Responses to this question are given in Table 5.

The results in Table 5 indicate that both the total group and the allied health group have good knowledge with respect to the treatment of hypermetropia, myopia, cataracts, glaucoma and retinal detachment. There are obvious deficiencies in the areas of presbyopia, diabetic retinopathy, senile macular degeneration (SMD), retinal vessel occlusion, ocular muscle palsy, entropion, herpes zoster, keratitis and ptosis.

DISCUSSION

While this study has revealed a wide range of ocular areas in which the public and allied health professionals have little knowledge its purpose was to examine specifically knowledge about vision in the elderly. Mitchell and Sarks,[3] have identified the principal causes of reduced vision in the elderly. On the basis of their data the prevalence is cataracts (22.4%), SMD (22.4%), glaucoma (4.5%) diabetic retinopathy (1.7%), and all others (2.1%). Neither group in this study identified SMD as being associated with aging, and both the total and allied health groups yielded inadequate percentages associating cataracts, glaucoma and diabetes with aging.

It is arguable if any of the above causes for decreased vision in the elderly are preventable, however, there do exist appropriate treatments for cataracts, diabetic retinopathy and glaucoma;

TABLE 5
Eye Complaints and Treatment(s). Percentages of respondents

Complaint	Treatment					Not treatable
	Uncertain	Glasses	Drugs	Surgery	Other	
Hypermetropia	5	82 (50)		2	2 (10)	
Cataracts	5	20 (20)	2	86 (90)	2 (10)	
Glaucoma	16		64 (80)	45 (70)	2 (10)	
Presbyopia	68 (30)	14 (30)	2 (10)			
Diabetic retinopathy	48	2	30 (60)		7	2
Senile macular degeneration	52 (20)	14 (10)	9 (60)		2	20 (50)
Retinal detachment	20	5	2 (10)	75 (90)	(10)	2
Myopia	2	95 (80)		2		
Retinal vessel occlusion	52 (10)	2	14 (40)	20 (20)	5 (10)	5 (10)
Ocular muscle palsy	48 (10)	9 (10)	9	16 (30)	18 (40)	2 (10)
Entropion	75 (30)			9 (40)		
Herpes Zoster	52 (10)		32 (60)		2 (10)	14 (20)
Keratitis	70 (20)		9 (50)	2 (10)		2
Ptosis	70		2 (10)	16 (50)	5 (20)	5 (10)

while the latter two diseases can cause permanent loss of vision the prognosis is greatly improved if the conditions are diagnosed early.

Cataracts, as a cause of decreased vision in the elderly, need not lead to permanent loss. With modern procedures and the use of intra-ocular lenses or contact lenses vision is frequently restored to 6/6.

Thus SMD which is neither preventable nor completely treatable (as yet) presents as a disease about which the population and the allied health group know very little. It is a disease whose progress can be temporarily arrested but which may eventually result in a significant loss of vision.

The implications of the above are clear. First, there needs to be a public education programme alerting the populace to the necessity of having early and regular ophthalmological assessments in order to detect onset of visually debilitating diseases. Second, where loss of vision is an inevitable result of a disease appropriate, Australia-wide, counselling services need to be established. Patients with such diseases should be counselled from the day the disease is diagnosed not from the point at which vision has deteriorated to a given state.

Third, education of allied medical personnel should include more detail on the aging eye and how such changes can affect patients. I would also suggest that such a course should also alert these people to various agencies and practitioners to whom they may refer. Fourth, government agencies, such as Health Departments, should establish vision screening clinics for those over 40 years of age with the specific task of detecting SMD, cataracts, glaucoma, diabetes and other ocular problems associated with ageing.

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A STUDY OF OCULAR SIGNS IN NORMAL AND PATHOLOGICAL AGING

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Abstract

This paper is a part of a larger study to define "senescent gait disorder". The ocular signs of three groups of patients are compared. Group 1 are normal senescent patients, Group 2 have senescent gait disorder and Group 3 have senile dementia of the Alzheimer type. Vision, stereopsis and ocular motility are evaluated.

Key words: *Visual acuity, stereopsis, ocular motility, normal senescence, senile gait disorder, senile dementia of the Alzheimer type.*

It is estimated that fourteen percent of the population will be over the age of sixty-five by the year 2000. As a consequence, normal and pathological aging must receive more attention from health professionals. As vision is involved in all tasks associated with daily living and leisure, preserving good sight in the elderly is of the greatest importance.

The main causes for failing vision in the elderly are senile macular degeneration, cataract and glaucoma. Ocular movements in the elderly and other ocular signs are useful diagnostic tools and markers of disease processes but have been given very little attention. Orthoptists with their special skills should be involved in studies of the normal and pathological ocular signs in the elderly.

With this in mind I became involved in a study of elderly subjects carried out at Lidcombe Hospital to try to define "Senescent gait disorder". In order to do this, three groups of subjects are studied, one—the normal group, two—the senescent gait disorder group and three—the senile dementia of the Alzheimer type group.

Senile gait disorder or (SGD) is a neurological disorder of gait and balance in elderly people which contributes significantly to disability. It affects 24% of the elderly, 75 and over living in our community.[1,2]

It is associated with flexed posture, mild generalised slowing and tendon reflex and eye movement changes.

Senile dementia of the Alzheimer's type (SDAT) is a dementia in which there are specific patterns of cognitive impairment, i.e. memory and praxis.

The clinical study in this paper, and more particularly in the planned longitudinal follow-up, was designed to determine whether SGD represented a normal aging of the nervous system or an early stage of a known neurological disorder of aging, in particular Alzheimer's disease.

METHOD AND RESULTS

Three age and sex matched groups are Group 1 ($n=41$) who were volunteers from the community and were without any gait or balance defect; Group 2 ($n=24$) who were volunteers

TABLE 1
Causes of Reduced Vision

	Normal	SGD	SDAT	Framingham	Mitchell/Sarks
Cataract	37.3%	37.5%	14.3%	15.5%	22.4%
S.M.D.	12.4%	0	0	12.7%	22.4%
Glaucoma	12.2%	16.7%	0	3.3%	4.5%
Strabismus	2.4%	4.2%	4.8%	—	—
Other	34.7%	16.7%	9.5%	—	3.8%

who had noticed difficulty with gait or balance, the senescent gait disorder group (SGD) and Group 3 ($n=21$) who were from nursing homes and who had a clinically confirmed diagnosis of senile dementia of the Alzheimer type (SDAT). Subjects with any neurological or orthopaedic disease affecting gait were excluded as were those with any medications which could affect the study.

Assessment was in five areas:

1. Clinical neurology/neuro-ophthalmology
2. Neuropsychology
3. Clinical neurophysiology
4. CAT scan
5. Blood examination.

The neurology assessment confirmed that the group of elderly subjects selected on the basis of a disorder of gait showed an increased frequency of flexed posture, slowing of limb movements, action tremor, absent ankle jerks and reduced vibration sense compared with the normal controls. The results of areas 2-5 are not yet available.

Ocular examination: The examination consisted of the taking of the history, visual acuity, VER's stereoacuity, cover tests, presence of nystagmus, ocular movements, range of pursuit movements, velocity of saccadic movements, convergence and fundus photographs. The glasses were checked to provide information to account for changes in visual acuity and were, as expected for this age group, bifocals, near glasses and aphakic lenses. Trauma was not significant.

Pathology: The known causes of reduced vision are compared with the analyses done by others.[3,4] The figures were higher in all groups but this may be due to being a relatively small sample.

Fundus photographs were not available at the time of publication and may alter the SMD figures in particular.

Distance visual acuity: The F test showed a difference in the right eye between the normal and the SGD group and between the normal and the SDAT group whereas the left eye did not. There is no explanation for this.

TABLE 2
Visual Acuity at Six Metres

Right eyes	Normal	SGD	SDAT	
Mean	2.29	2.79	3.29	$p=<0.05$

t test: normal versus SGD 2.825 (significant)
normal versus SDAT 2.758 (significant)
SGD versus SDAT 1.226 (not significant)

Left eyes	Normal	SGD	SDAT	
Mean	2.22	3.0	2.81	$p=<0.05$

t test is not significant.
Key: 1 = 6/6; 2 = 6/9; 3 = 6/12; 4 = 6/18, 6/24; 5 = <6/24

Near vision: There was no significant difference between the groups.

TABLE 3
Visual Acuity at ⅓ Metre

	Normal	SGD	SDAT
Mean	1.44	1.42	1.81

Key: 1 = N5/N6; 2 = N8/N10; 3 = N12/N16; 4 = N18; 5 = <N18.

VER: The VER showed a reduced latency in the normals compared to known standards for younger subjects. The SGD and SDAT groups had an even longer latency. Eyes with reduced acuity and obvious pathology were not tested.

TABLE 4
VER Latency (milliseconds)

	Normal ($n=67$)	SGD ($n=39$)	SDAT ($n=31$)
Mean	116.9	123.4	121.7

Stereoacuity: An analysis of all patients in the three groups showed no significant difference. A further analysis was then done using only those subjects who met the same criteria as used in another survey[5] i.e. near visual acuity of N5, orthophoria or heterophoria only and good convergence (near point of less than five centimetres). The *t* distribution showed that the SGD and the SDAT groups were significantly below the normal group but that there was no difference between the SGD group and the SDAT group.

TABLE 5
Stereopsis (Seconds of Arc) on Wirt-Titmus Test, with Criteria as Described

	Normal	SGD	SDAT	
Mean	55.5	78.18	110	($p=<0.05$)

t test: normal versus SGD 2.223 (significant)
normal versus SDAT 3.408 (significant)
SGD versus SDAT 1.210 (not significant)

Cover Tests: The prevalence of constant strabismus was 7.85%, higher than in the younger normal population, but lower than the prevalence found by Longhurst and Macfarlane[6] of 17%. However an analysis of the groups shows that the SDAT group has a significantly higher prevalence of strabismus and a lower prevalence of heterophoria. The normal and SGD groups are similar to one another.

Nystagmus: This was not significant as the numbers were too small.

Ocular movements: Ocular rotations were performed and underactions, overactions and 'A' and 'V' patterns were noted but these were not statistically significant.

Abnormal pursuit movements were noted in five subjects in the normal group, seven subjects in the SGD group and in five subjects in the SDAT group. They mostly showed a cogwheeling type of pursuit movement.

Range of ocular movements: From the literature the normal limits of upward gaze vary from forty to fifty degrees in young subjects.[7,8,9] It has been noticed that a reduction in elevation occurs in the elderly but Chamberlain[10] tested elevation monocularly. Since in normal ocular movement situations both eyes elevate together, measurements were taken with both eyes elevating together in case the input from both eyes differed from each eye on its own.

A simple test seemed preferable in view of the age and concentration of the subjects especially the SDAT group.

The head was placed on the centre of the chinrest of the Rayner arc perimeter with the eyes level with the central target. A light was moved along the perimeter arc with the examiner and an observer watching the light's reflection on the subject's pupil. The instant the reflection moved from its normal position this was considered the limit of movement and recorded in degrees. An N5 target would have been preferable to ensure that foveal fixation was maintained but this presented too many problems.

From the following the differences in velocity can be seen between the groups.

Range of elevation: Mean—Normals 48.54°; SGD 42.67; SDAT 43.85°. There was a signifi-

TABLE 6
Cover Test

	Distant cover test			Near cover test		
	Normal	SGD	SDAT	Normal	SGD	SDAT
Strabismus	7.5%	8.3%	12.5%	4.88%	4.17%	9.5%
Heterophoria	27.5%	12.5%	6.25%	70.73%	79.17%	66.7%
Orthophoria	65%	79.2%	81.25%	21.95%	12.5%	14.29%
Int. strab.				2.44%	4.17%	9.52%

cant difference between the normal group and the SGD group.

Range of depression: Mean—Normals 59.17; SGD 57.83; SDAT 63.85. There was a significant difference between normals and the SGD and between the SGD and SDAT groups.

Range to the right: Mean—Normals 58.61; SGD 57.38; SDAT 58.85. There was no significant difference.

Range to the left: Mean—Normals 57.07; SGD 56.53; SDAT 56.45. There was no significant difference.

Further statistical analysis is available on request.

Velocity of ocular movements: Still using the arc perimeter, a light was placed at 30°. The patient was asked to look from the central white target straight ahead (0 degrees) to the light at 30°. The time taken to do six saccadic movements from the light to the target was recorded by stopwatch with an observer. Undershoots, overshoots difficulty in initiating the saccade, and slowness in initiating the saccade were noted. Abnormal saccades were found in 12 of the normal group, 8 of the SGD group and 7 of the SDAT group. These figures were not significant between the groups.

TABLE 7
Velocities in Seconds

Mean in seconds	Normal	SGD	SDAT
Elev.	3.49	3.93	5.01
Dep.	3.31	3.91	5.07
Right	3.32	3.97	4.59
Left	3.44	3.75	4.63

Elev. Significant difference between normal and SDAT and SGD and SDAT
Dep. Significant difference between normal and SGD and normal and SDAT and SGD and SDAT
Right: Significant difference between normal and SGD and normal and SDAT
Left: Significant difference between normal and SDAT and SGD and SDAT

Convergence: The means show a significant difference between the normal and the SGD and the SDAT groups but the *t* distribution shows a difference between the SGD and the normal groups and not the SDAT group.

TABLE 8
Convergence

	Normal	SGD	SDAT
Mean (cm)	3.86	7.25	6.11

t test: SGD versus normal 2.587 (significant)
SDAT versus normal 1.313 (not significant)
SGD versus SDAT 0.621 (not significant)

DISCUSSION

From study of the tables a normal elderly subject has some reduction in visual acuity, stereopsis and the range of elevation. Also the incidence of strabismus is higher, probably due to a larger number of eyes with markedly reduced vision. Velocities in all directions are slower compared with younger subjects, between 3.0 secs and 3.5 secs for elderly subjects and 1.9 and 2.2 secs for younger subjects.[11]

The SGD group shows differences from the normal group in the following areas; stereopsis with criteria, range of depression and elevation, velocity of depression, elevation and dextroversion, convergence and VER latency.

The SDAT group show differences from the normal group in the following areas, stereopsis with criteria, strabismus, range of elevation, velocity in all directions, convergence and VER latency. Therefore there is a similarity between the ocular signs of the SGD subject and the SDAT subject as both differ from the normal group in stereopsis with criteria, range of elevation, velocities, convergence and VER latency. It remains to be seen if this is a consistent finding in the other areas of examination to link these diseases.

It can be seen how important it is to have knowledge of the ocular signs of the normal elderly subject in order to evaluate the pathological signs. It is to be hoped that gerontology is a field of study for orthoptists in the future.

ACKNOWLEDGEMENTS

I would like to thank Drs Broe and Williamson for asking me to participate in this study and Dr

Sarks for her support. I also would like to thank Dr Carter for allowing the use of the facilities of Lidcombe Hospital.

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THE ROLE OF SACCADIC VELOCITY TESTING IN THE MANAGEMENT OF ORBITAL FRACTURES

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Abstract

The aim of this study was to record and compare saccadic ocular movements in patients who sustained orbital trauma and/or orbital fractures. Seventeen patients were used. Ocular saccadic velocities were measured vertically (and horizontally) using a Tracoustic Saccadic Velocity Recorder. Patients with only orbital oedema and haemorrhage, who presented with a clinical picture of blow out fracture, gave normal saccadic velocity readings and ocular deviation disappeared soon after trauma. In patients with orbital fractures, saccadic velocity measurements proved to be helpful in identifying those patients who would have a persistent deviation after surgical repair of the fracture.

It is shown that saccadic velocity measurements can differentiate limitation of ocular rotation secondary to orbital oedema and haemorrhage and tissue incarceration, from those due to inferior rectus muscle paresis, even in mild cases. This information is of value to the surgeon in deciding management of the case.

Key words: *Saccadic velocities, orbital trauma, limitation of rotation, extraocular muscle paresis.*

INTRODUCTION

Saccades are rapid and precise conjugate eye movements from one fixation point to another. A saccade is induced by a sudden burst of motor unit activity which is immediately followed by an orderly firing pattern. During a saccade, there is a heightened burst of activity of the agonist, inhibition of the antagonist, and coactivity of the auxiliary extraocular muscles. The duration and velocity of saccadic eye movements are dependent upon the strength of the agonist. Reduction in saccadic velocity is an excellent index of qualitative reduction in muscle function. Conversely, recovery of velocity is an index of recovery in muscle function.

In patients with orbital fracture, in particular with orbital floor fracture, the orbital content, including orbital fat, extraocular muscle or muscles and Tenon's capsule, may be forced into the fracture site.

Findings of orbital tissue incarceration include ocular muscle imbalance, diplopia and restriction of ocular rotation. Depending upon the extent of the trauma and the injury caused by the incarceration, the extra ocular muscle involved may be paretic or functionally normal.

Additionally, paresis of an extraocular muscle, orbital oedema and haemorrhage may produce findings similar to those of orbital tissue incarceration and needs to be differentiated, in order to carry out the most appropriate treatment.

In all situations, diagnosis of the true condition may be assisted by roentgenographic (plain x-ray) and polytomographic views. These often show displaced bone or clouding of involved sinuses sometimes leaving the diagnosis unclear.

The purpose of this study was to investigate the use of saccadic velocity recordings to differentiate ocular muscle involvement in patients with orbital trauma and/or orbital fracture, thus aiding the management of these patients.

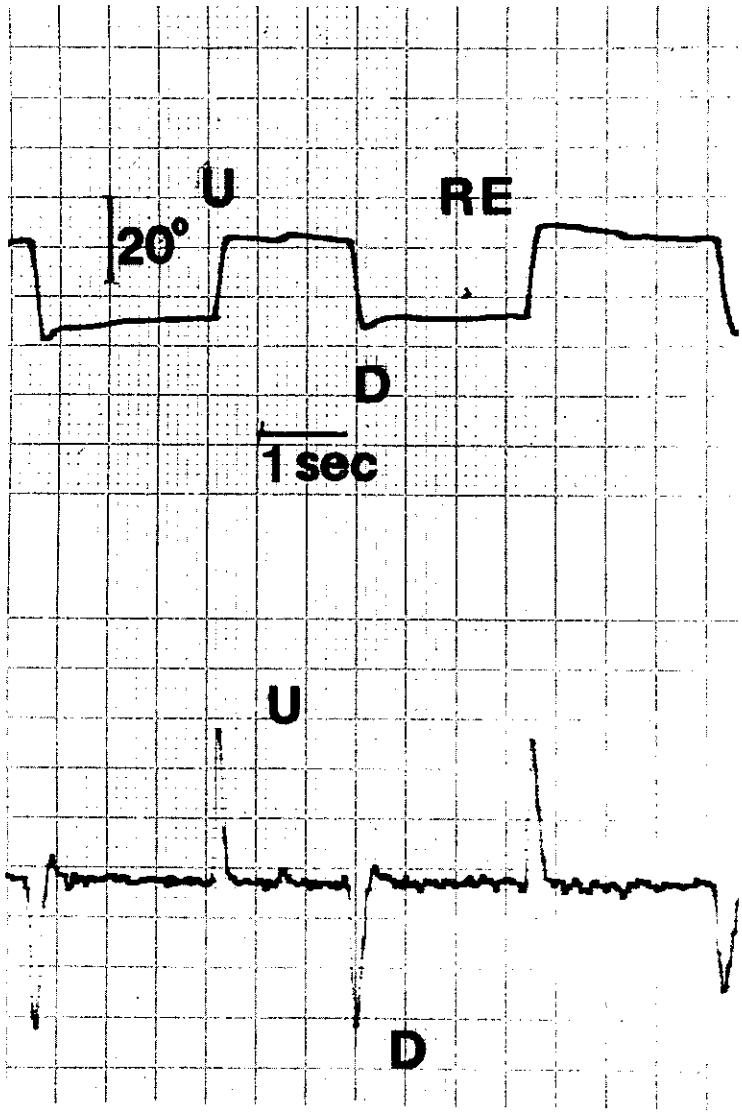

Figure 1: Velocity recording of vertical saccades of patient with orbital oedema and haemorrhage without fracture, right eye. Upper tracing, eye position, lower tracing, velocity. Upward (U) and downward (D) saccades are rapid and equal (300 degrees/sec cm) indicating normal ocular muscle function.

METHOD

A Tracoustic Saccadic Velocity Recorder, a form of electrooculography, was used to record and measure saccadic eye movements in patients with trauma to the orbit and/or with orbital fractures.

The recorder utilizes 5 miniature electrodes. To measure vertical saccades, electrodes were placed above the brow and below the lower lid of each eye, with a neutral placed centrally on the forehead. For horizontal saccadic measurements, electrodes were placed medially and laterally at each canthus with the neutral placed as above.

Saccades were generated by voluntary movements made between fixation points

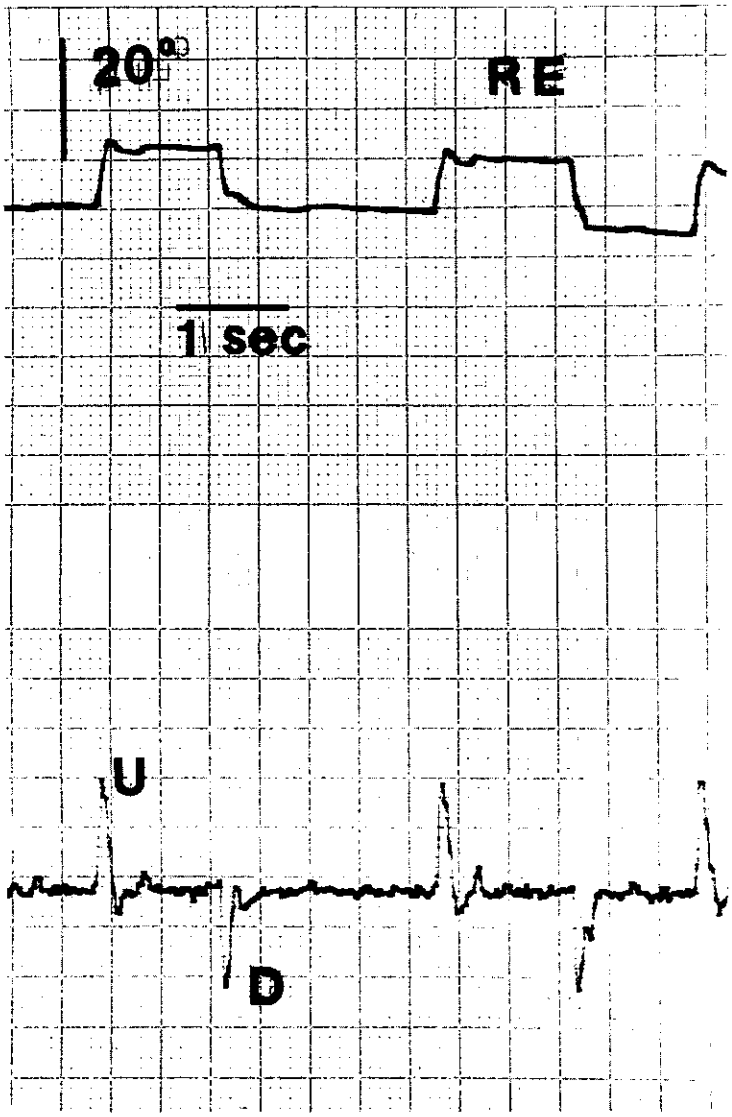

Figure 2: Velocity recording of vertical saccades of patient with orbital floor fracture, right eye. Upper tracing, eye position, lower tracing, velocity. Upward (U) saccades (240 degrees/sec cm) are slightly greater than downward (D) saccades (220 degrees/sec cm) indicating mild right inferior rectus paresis.

situated 20 and 40 degrees apart. Eye movements were made where the eye was able to move freely.

Patients

The study included 17 patients who were divided into three main groups:

1. Five patients sustained trauma to the orbit, producing orbital oedema and haemorrhage and a clinical picture of blowout fracture. Roentgenographic and polytomographic findings were normal.

2. Six patients had orbital floor fracture, confirmed surgically and/or roentgenographically and polytomographically. In this group there was no persistent ocular deviation in the primary position.

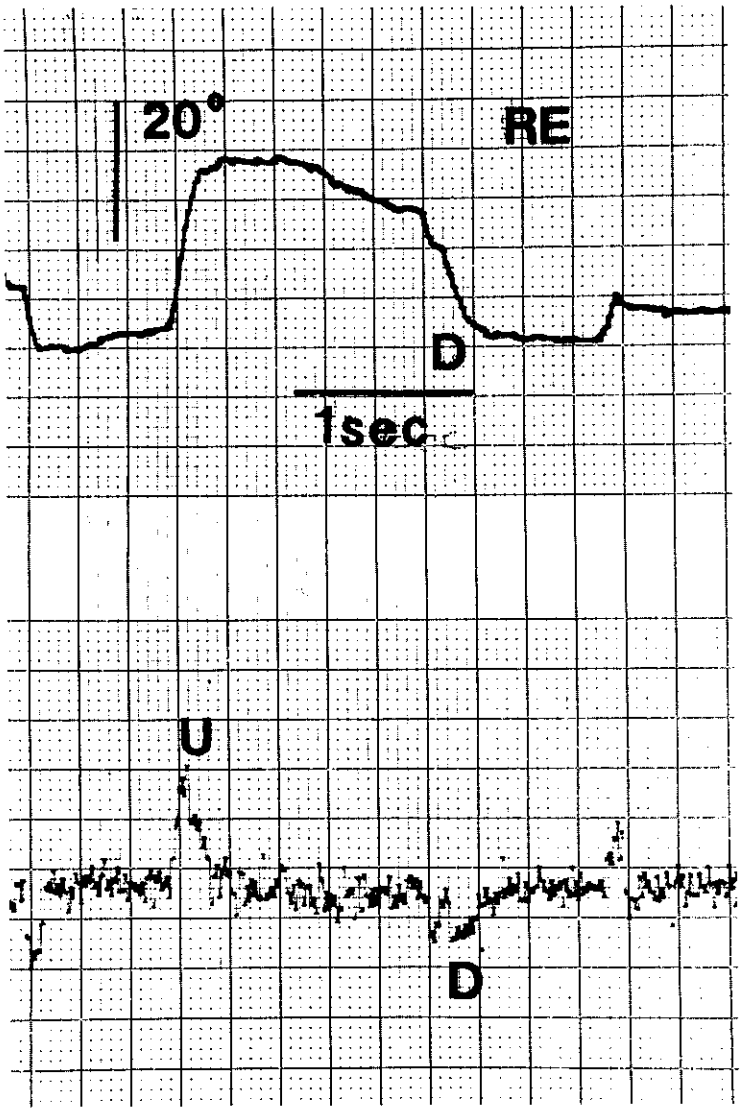

Figure 3: Velocity recording of vertical saccades of patient with orbital floor fracture, right eye. Upper tracing, eye position, lower tracing, velocity. Upward (U) saccades are rapid (250 degrees/sec cm) while downward (D) saccades are slow (100 degrees/sec cm) indicating normal right superior rectus muscle and paresis of right inferior rectus muscle.

3. Five patients had orbital floor fracture, confirmed as above. Three patients in this group also had associated zygomatic fractures and all patients had persistent ocular deviation in the primary position, on the side of the trauma.

There was one additional patient with a fracture of both the medial wall and orbital floor. This patient also had a persistent ocular deviation in the primary position, on the side of the trauma.

RESULTS

Saccadic velocities were recorded and measured on all subjects.

Based on the Metz *et al.*[1] method of calculation of saccadic velocities, the average percentage difference between upward (U) and downward (D) and between left (L) and right (R) saccadic velocity was used to assess the patients in this study.

In group one, saccadic velocities were equal and rapid in all cases (Fig. 1). Ocular deviation disappeared soon after trauma. Surgical intervention was not required.

In the second group, the average percentage difference between upward and downward saccadic velocity was 26%, with a range of 10% to 33% (Fig. 2). In all cases there was no deviation in the primary position, either without surgery or within four months after repair. Two patients had surgical repair of the fracture site.

In group three (Table 1) the average percentage difference between upward and downward saccadic velocity was 97.8% with a range of 60% to 150% (Fig. 3). Upward saccades were always faster than downward saccades. In all cases there was a residual hyperdeviation in the primary position up to eight months after repair. Two cases also had associated exotropia. All patients had surgical repair of the fracture site.

TABLE 1

Patient (group 3)	Post-op deviation in primary position (Δ)		Average % difference in saccadic velocities (U > D)
1	3^{Δ} Hypert	3^{Δ} Exot	60%
2	4^{Δ} Hypert		66%
3	8^{Δ} Hypert		89%
4	10^{Δ} Hypert	4^{Δ} Exot	124%
5	14^{Δ} Hypert		150%

A correlation between the amount of postoperative residual deviation and the average percentage difference in saccadic velocities was found. The greater the hyperdeviation, the greater the percentage difference in saccadic velocities (Table 1).

The patient with the right medial wall and floor fracture had a vertical saccadic velocity reading of 100% difference (U > D) and a horizontal reading of 128% difference (L > R). A hyperdeviation of 10 prism dioptres and a divergent deviation of 12 prism dioptres remained. Surgical repair of the fracture site was performed.

DISCUSSION

Saccadic velocity recordings proved helpful in identifying those patients who would have a persistent deviation either with or without repair of the fracture site.

Results of this study showed that:

1. Patients whose range of vertical saccadic velocities was less than 35% difference from upward to downward (U > D) had no residual deviation or diplopia either without surgical repair, or within four months after repair and required no further treatment. The clinical significance of this finding is that any patient whose saccadic velocity reading was less than 35% difference from upward to downward (U > D) will eventually gain full ocular motility.
2. Those patients whose range of vertical saccadic velocities was 60% or greater (U > D) had a residual hyperdeviation and diplopia after surgical repair of the fracture site. The deviation persisted up to eight months after repair. The clinical significance of these results suggest that patients who have a 60% or greater difference from upward to downward (U > D) saccadic velocity will have impairment of ocular motility due to inferior rectus paresis. In the case of the medial wall and floor fracture patient saccadic velocity measurements indicate inferior rectus (100% U > D) and medial rectus (128% L > R) paresis.

A clinical correlation was found in the 60% or greater group (3), the greater the hyperdeviation, the greater the percentage difference between upward and downward saccadic velocity.

The findings of this study compare well with the results of the study by Metz *et al.*[1] who found that when the difference between upward and

downward saccadic velocity (U > D) was less than 30%, (group 1) patients could fuse either with or without surgical repair. When the difference between upward and downward saccadic velocity (U > D) was 51% or more, (group 2) patients had persistent vertical diplopia and hyperdeviation, post surgical repair. This was secondary to inferior rectus weakness. In their second group, generally, the greater hyperdeviation had the greater percentage difference between upward and downward saccadic velocity.

According to some investigators[2,3,4] a large majority of blowout fractures of the orbital floor do not require surgical treatment. They explain many of the typical symptoms and findings as secondary to orbital haemorrhage and oedema or mild paresis of the inferior muscles.

As can be seen from this study, saccadic velocity measurements can differentiate limitation of ocular rotation secondary to orbital oedema and haemorrhage and tissue incarceration, from those due to inferior rectus muscle paresis, even in mild cases.

This information is of great value in the management of patients with orbital trauma and/or orbital fractures, especially if there is inconsistency in signs, symptoms and roentgenographic and polytomographic findings.

Measurement of saccadic velocity also gives an index of the extent of ocular muscle paresis and documents recovery or lack of recovery of muscle function during the follow up period. This information is of assistance to the surgeon in deciding, if surgery is indicated, when to operate and which procedure would give the best functional result.

Saccadic velocity recording can be performed on children, causes no discomfort and is a technique easy to perform and interpret.

SUMMARY

Seventeen patients were used in the study. Ocular saccadic velocities were measured vertically (and horizontally) using a Tracoustic Saccadic Velocity Recorder.

Patients with only orbital oedema and haemorrhage who presented with a clinical picture of blow out fracture, gave normal saccadic velocity readings and ocular deviation disappeared soon after trauma.

In patients with orbital fractures, saccadic velocity measurements proved to be helpful in identifying those patients who would have a persistent deviation after surgical repair of the fracture.

Patients with orbital floor fracture, whose range of vertical saccadic velocities was less than 35% difference from upward to downward (U > D), had no residual deviation or diplopia either without repair of the fracture site, or within four months after repair and required no further treatment. Those patients with orbital floor fracture whose range of vertical saccadic velocities was 60% or greater (U > D) had a persistent hyperdeviation and diplopia, after repair of the fracture site, up to eight months after repair. This indicates inferior rectus paresis. The patient with the right orbital floor and medial wall fracture gave a vertical saccadic velocity reading of 100% difference (U > D) and a horizontal saccadic velocity reading of 128% difference (L > R). This patient had a persistent vertical and horizontal deviation and diplopia after fracture repair. This indicates right, inferior rectus and medial rectus paresis. These patients will be followed at regular intervals to measure recovery or lack of recovery in muscle function.

This information is of value to the surgeon in deciding, if surgery is indicated, when to operate and which procedure would give the best functional result.

ACKNOWLEDGEMENTS

I wish to thank Dr J. Graham Henry for his continual encouragement and Dr Roger Williams for introducing me to saccadic velocities.

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OPHTHALMOLOGICAL ASPECTS OF FRONTO-ETHMOIDAL MENINGOENCEPHALOCELES FROM THE SOUTH EAST ASIAN REGION

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Abstract

Fronto-ethmoidal meningoencephaloceles for reasons unknown, are far more common in South East Asia than in most other regions of the world; and account for 25% of overseas referrals to the South Australian Cranio-Facial Unit. We reviewed twelve consecutive cases presenting to our Unit. All patients were of Malay or Indian origin, no cases were familial, but mean paternal age at the child's birth was above normal. Cases were assessed by clinical examination, X-rays, with subsequent confirmation at surgery. In all cases the encephalocele exited via the foramen caecum, with entry on to the face being one of three types; naso-frontal, naso-ethmoid, and naso-orbital. There was considerable medial canthal displacement, moderate globe displacement, and minimal lateral canthal displacement. All cases showed an elongated face. The encephalocele appears to act as a foreign body displacing the eyes laterally, and the mid-face downwards, acting quite differently to normal facial clefts. Ocular abnormalities included hypertelorism, telecanthus, non-functioning lacrimal apparatus, orbital dystopia, and squint. Binocular vision was usually present. Surgery involved shifting one or both orbits, or medial orbital walls only, to correctly position the eyes. Complications were minimal, but included convergent squint, which usually resolved without treatment.

Key words: *Encephalocele, hypertelorism, cranio-facial surgery, facial deformity.*

Fronto-ethmoidal meningoencephaloceles are exceptionally rare deformities in most regions of the world, but for reasons which are currently obscure, they appear to be much more common in South East Asia and adjacent regions of the world, though not in the European population of Australia. Only three of 41 cranial encephaloceles reported in one series from Australia were of the fronto-ethmoidal variety and two of these were Aborigines. However, in Thailand the ratio is 100 fronto-ethmoidal encephaloceles for every 15 of all other types of encephaloceles combined. Not surprisingly, these lesions which cause a major disruption to the face represent a significant percentage of referrals to the S.A. Cranio-Facial Unit for correction. Approximately 25% of all cases referred to the Unit from South East Asia have fronto-ethmoidal meningoencephaloceles as the major problem. This paper reviews our experience with this lesion, based on the first 12 consecutive cases.

CLINICAL MATERIAL

Twelve cases of fronto-ethmoidal meningoencephalocele were referred to our unit over a two and a half year period, of which ten were children of Malay descent, and two children of Indian descent. All cases were sporadic. There were no familial cases, and none of the families had relatives with other neural tube defects. The mean position of the child in the family was fifth, and there were an equal number of females and males. In all cases the pregnancy was apparently normal. Parental ages at time of birth were noted for all cases, and the paternal age mean was 36 years, maternal age mean 28. This indicates a significantly higher mean paternal age than might

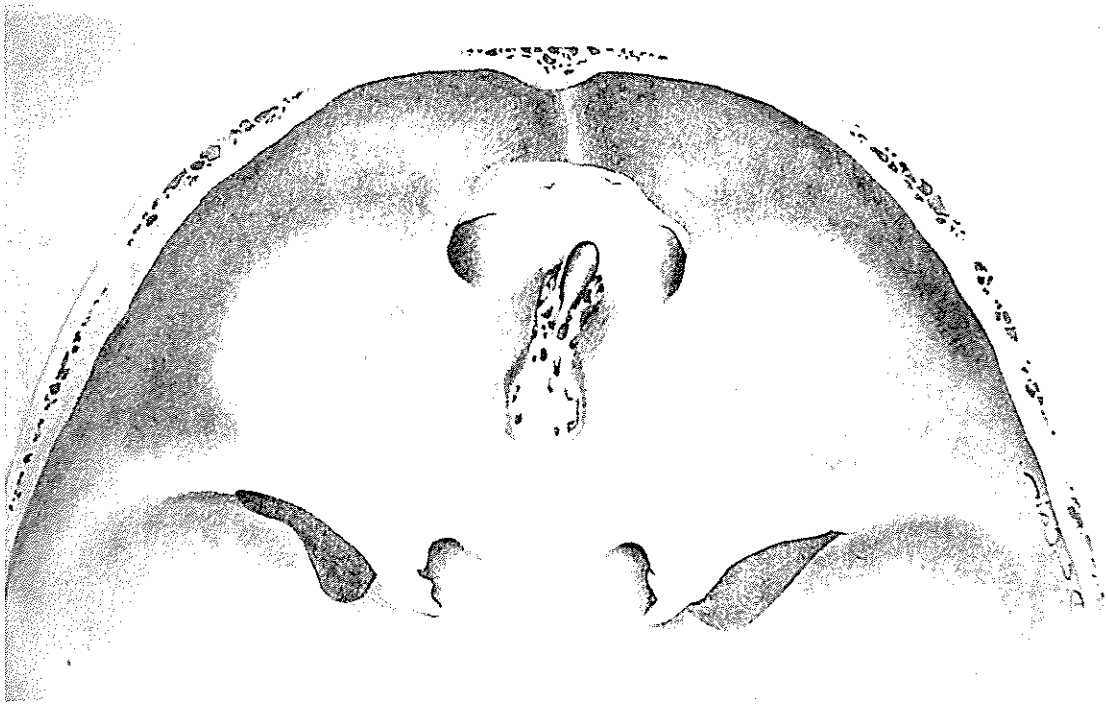

Figure 1: Medical artists rendition of the defect in the anterior cranial fossa in the region of the foramen caecum where the meningoencephalocele exits towards the face, based on the appearance of x-rays and this region at surgery.

be expected in the community, based on the Australian experience, but detailed figures for Malaysian society are not available, although it would appear that there is a tendancy to marry young.

All patients underwent routine extensive cranio-facial workup prior to surgery which included a complete ophthalmological examination including measurements of distances between the medial canthi, mid-pupil, and lateral canthi. Anatomy of the lesion was determined using cephalometric x-rays, conventional tomography, and CT scans. Following investigation all cases underwent cranio-facial surgery to remove the encephalocele, rebuild the nose, and correct any orbital displacement.

RESULTS AND DISCUSSION

All of our cases presented with a significant facial deformity secondary to the herniating meningoencephalocele. In all cases the encephalocele extruded through the foramen caecum, displacing the eyes laterally, the nose inferiorly, causing a varying degree of telecanthus and hypertelorism with a long midface (Figure 1).

Suwanwela has reviewed a series of fronto-ethmoidal meningoencephaloceles presenting in Thailand, and has provided a sub-classification of this deformity based on autopsy findings in those patients which died in childhood. Our studies confirmed this classification.

The first subgroup is the naso-frontal type where the skull defect presents at the root of the nose, pushing the nasal bone inferiorly. The cribriform plate, crista galli, and associated anterior cranial fossae are tilted downward resulting in a deep cranial fossa centrally.

The second subgroup is the naso-ethmoid type, where the nasal bones remain attached to the frontal bone, and the encephalocele presents between the nasal bones above and the nasal cartilage and septum below.

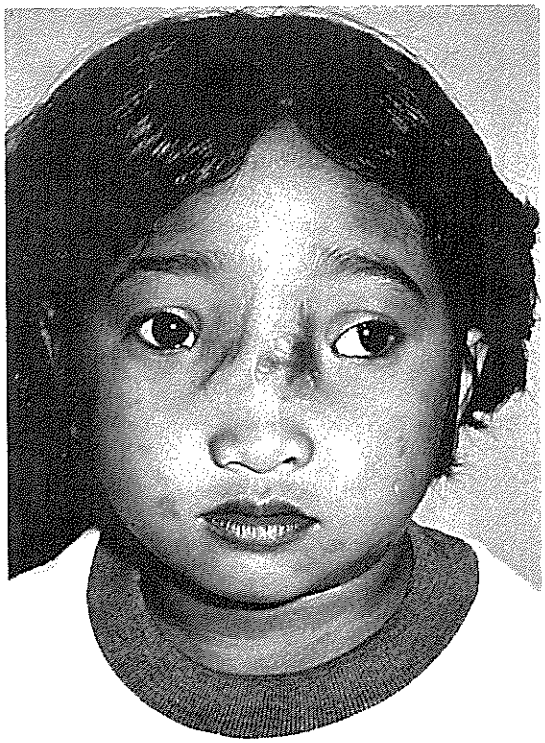

Figure 2: Malaysian child with fronto-ethmoidal meningoencephalocele showing moderate hypertelorism, with telecanthus, and displacement of the midface downwards causing a long face.

The third group is the naso-orbital type, which was the most common in our series, where the frontal and nasal bones were in their normal relationship, but the frontal process of the maxilla was defective on one or both sides, with protrusion of encephalocele through the medial orbital walls unilaterally or bilaterally.

Analysis of the orbital measurements revealed an interesting situation. The medial intercanthal distance was greater than the 97th percentile for age in all but one of our cases. The interpupillary distance was less dramatic, with most at or just above the 97th percentile for age, but several actually below this figure. The lateral intercanthal distance was the least distorted, with all cases at or below the 97th percentile for age. This indicates a greater degree of telecanthus than actual hypertelorism in nearly all cases. Our interpretation of these figures and other facial features, especially the elongated face, is that the encephalocele acts as a foreign body displacing an otherwise normal anatomy. (Figure 2).

This contrasts with the classic cranio-facial clefts described by Paul Tessier in which there is a wide face, hypertelorism, and maxillary hypoplasia with shortening and retrusion of the middle third of the face.

The ocular abnormalities arise either specifically from the primary anatomical defect

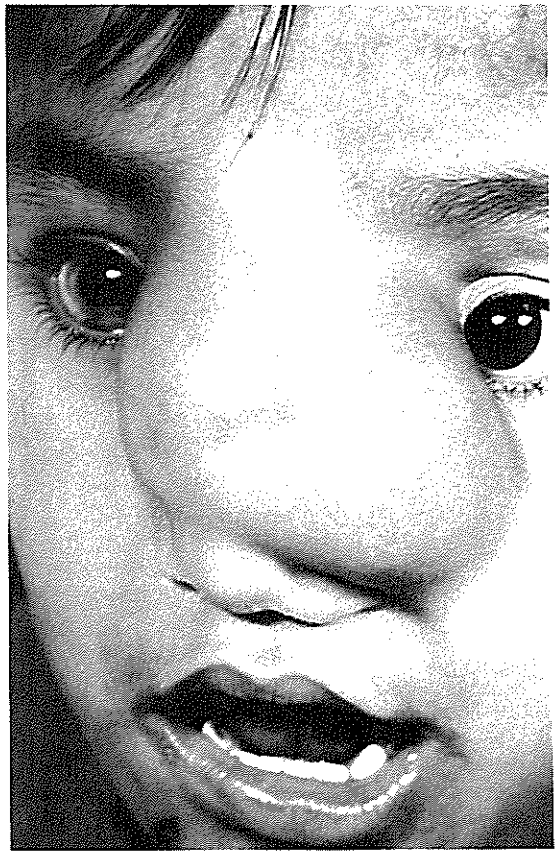

Figure 3: Malaysian child with very large naso-frontal type encephalocele projecting forward as a probosis like structure displacing the eyes laterally and the nose downwards.

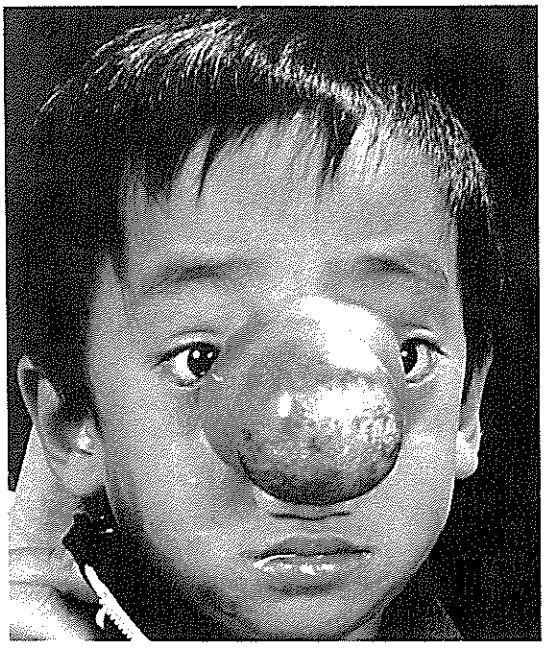

Figure 4: Malaysian child with large encephalocele displacing the orbits, and with the right eye showing a central corneal leucoma and some microophthalmia.

or as a separate ophthalmological problem in association with it. The first group includes the hypertelorism and telecanthus which have followed from the displacement of the orbits laterally, and the resultant filling of the median defect with dysplastic and usually gliotic non-functioning cerebral tissue (Figure 3).

Five cases in which the encephalocele presented through the medial orbital walls have watering eyes with destruction of the normal lacrimal apparatus. The abnormality was so extensive that generally I was not sanguine of success from such procedures as routine dacrycystorhinostomy or the insertion of a Lester Jones tube, as in all cases the lacrimal anatomy was either absent or grossly distorted at the inner canthi.

In two cases there was a significant degree of orbital dystopia with the encephalocele displacing one eye superiorly. This causes few ocular problems and does not preclude the development of binocular vision and stereopsis provided the visual axes remain parallel.

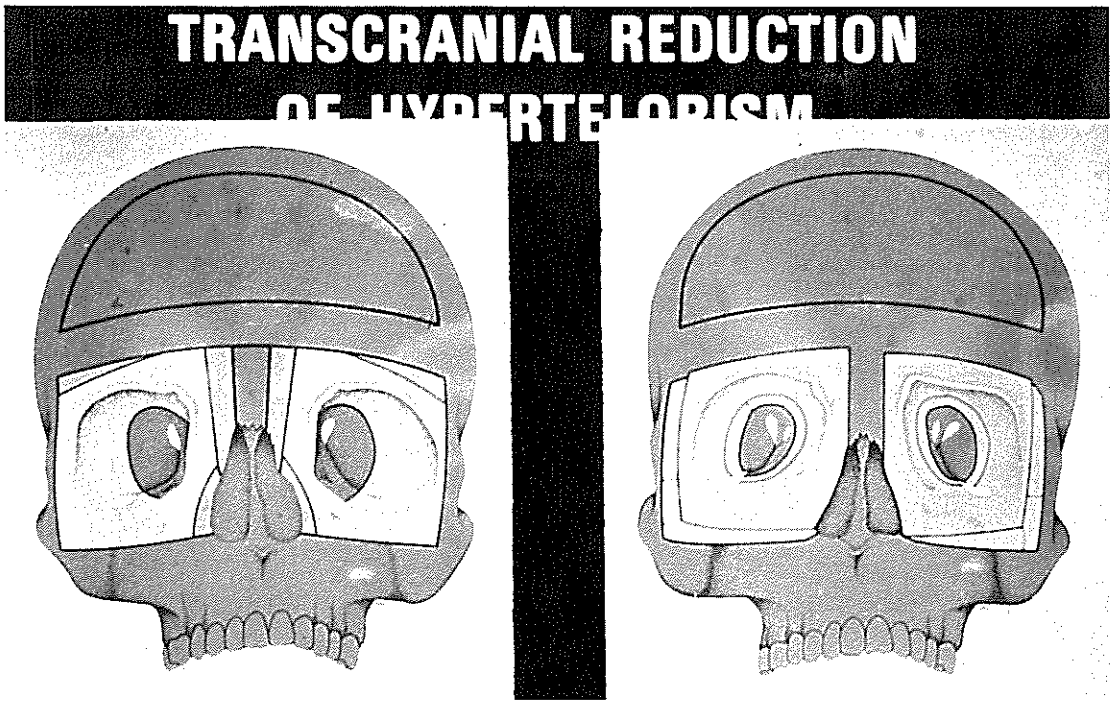

Figure 5: Diagram showing the way bone is removed to allow medial translocation of the orbits for correction of bilateral hypertelorism.

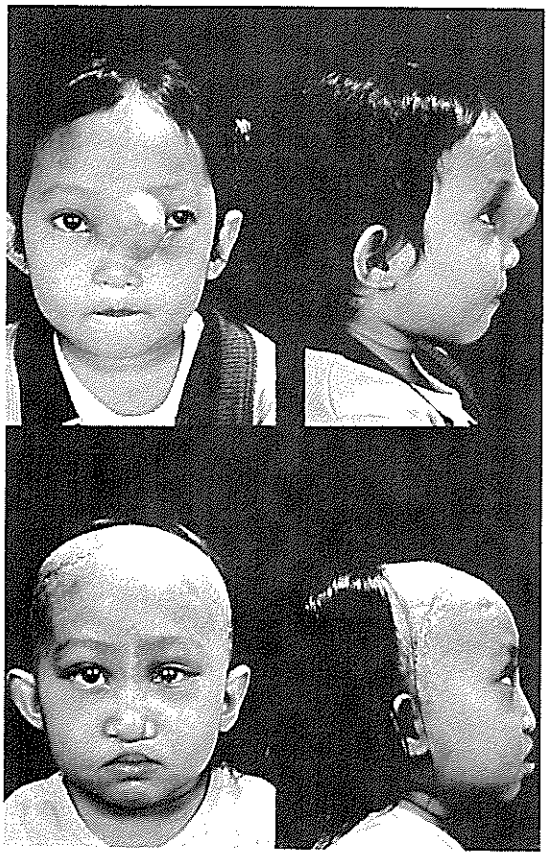

Figure 6: Malaysian child with moderate sized fronto-ethmoidal meningoencephalocele causing hypertelorism, shown immediately prior to, then two weeks following cranio-facial correction of the deformity. At this stage the shaven hair has not yet regrown, and suture lines are obvious. These will fade with time.

There were three other cases where the ocular findings were not so closely related to the primary pathology. In one child, who is one of the few cases showing measurable mental retardation, there was a microophthalmic right eye with a dense central corneal leucoma, and here the vision in the opposite eye was normal (Figure 4). Two cases had squints, the vision being normal in each eye in one case, and defective in the left eye in the second. This eye was amblyopic from a significant degree of anisometropia. In one case there was a 40° concomitant convergent squint, and this required surgery two weeks after the major cranio-facial procedure was performed. In all other cases vision was normal in both eyes.

Surgical planning is based on radiological assessment, measurement, and clinical assessment. The operation is via a transcranial approach so that the defect can be isolated intracranially and possibly intradurally, thus securing adequate repair of the dura. Surgery should aim at repairing the boney and soft tissue deformities in one operation rather than multiple procedures. Where necessary complete translocation of both orbits was peformed (Figure 5). The translocated orbits are firmly wired in the new position, and the ocular tissues are carried to the new position within the shifted orbit. The nose is rebuit using rib harvested from the right rib cage. In the naso-orbital cases, one orbit is frequently much more displaced than the other and so it is possible to accomplish a good surgical result by selectively moving only one orbit. Residual telecanthus following nasal reconstruction and the removal of soft tissue elements is corrected using trans-nasal canthopexy. Where there is excessive nasal skin this must be excised leaving a vertical median scar on the nose which in these Malaysian patients rapidly becomes virtually invisible. Only redundant skin should be excised, as there is considerable contraction of associated tissues post-operatively.

In our small series of 12 cases there have been no major complications. Of the minor complications the most significant was a left convergent squint secondary to a left lateral rectus palsy. These are usually associated with orbital surgery for hypertelorism, where the lateral rectus is possibly stretched in the relocation of the transposed orbit, or traumatised in splitting the lateral orbital wall. Most cases recover spontaneously over six to nine months, but in patients from South East Asia where return visits are difficult, as much treatment as possible is carried out whilst in Australia, so that on this occasion the squint was repaired prior to return to Malaysia. There was one minor nasal infection in the nasal wound, one case of immediate post-

operative convulsion associated with hydrocephalus, which settled readily with treatment.

The bizarre cases are a challenge to our craniofacial unit. They appear to be largely restricted to a well defined geographical area, in people of predominantly non-European descent. Results achieved appear excellent, even in the short term (Figure 6), and follow up so far has indicated that both the cosmetic and functional aspects continue to improve with time. Successful surgery is rewarding for everyone involved, but most of all for the patients, who can once more take their place in society and not live as shunned outcasts in its shadow.

ACKNOWLEDGEMENTS

I would like to thank my colleagues on the South Australian Cranio-Facial Unit for their help in providing information about these patients, and in particular Mr D. J. David, Chief Surgeon and Head of the Unit.

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A SIMPLE TEST OF SPATIAL FREQUENCY DISCRIMINATION IN PATIENTS WITH MULTIPLE SCLEROSIS

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Abstract

A simple spatial frequency discrimination test was designed with gratings ranging from 0.28 to 35.0 seconds per degree of visual angle, and presented to two groups of subjects.

The first group consisted of 16 normals. The second, a group of 18 subjects from the Multiple Sclerosis Society, consisted of three with other neurological disorders and 15 with definite multiple sclerosis (MS).

Results show that the MS group was significantly less able to perform the test correctly (although the visual acuity was usually 6/9 or better) and showed a marked response of confusion, even though instructions were clearly understood.

Key words: *Spatial frequency discrimination, multiple sclerosis.*

Multiple Sclerosis (MS) is a diffuse nerve disease in which demyelination of the visual pathway is an almost universal consequence, although visual abnormalities are not always evident in clinical testing.[1]

However, testing spatial frequency discrimination at different levels of contrast sensitivity has shown that patients with MS may have an abnormal modulation transfer function with a selective visual loss to medium spatial frequencies in the presence of normal Snellen's acuity.[1,2]

These gratings are usually generated electronically on an oscilloscope screen or are available as a set of printed gratings of varying contrast and spatial frequencies. However, neither is easily available for routine testing.

It has recently been suggested[3] that subjects with MS may also have difficulties with discrimination between varying spatial frequencies when sensitivity is normal, and the level of contrast is constant. With this in mind, a simple clinical test was designed and tested on a group with known MS to determine whether there was any significant difference in the response of this group compared with that of a normal group.

METHOD

Twenty four discs, each with a diameter of 5 cm, were constructed. Each disc consisted of a black and white grating (i.e. 100% contrast) of a particular spatial frequency ranging from 0.28 to 35 cycles per degree at 40 cm (i.e. from fine stripes approximately 0.1 mm wide to broad stripes approximately 1.3 cm wide). These were numbered 1 to 24 on the back and mounted onto a white card (8 cm square), and covered with a protective coating. For ease of use they were divided into three subsets, set A contained the

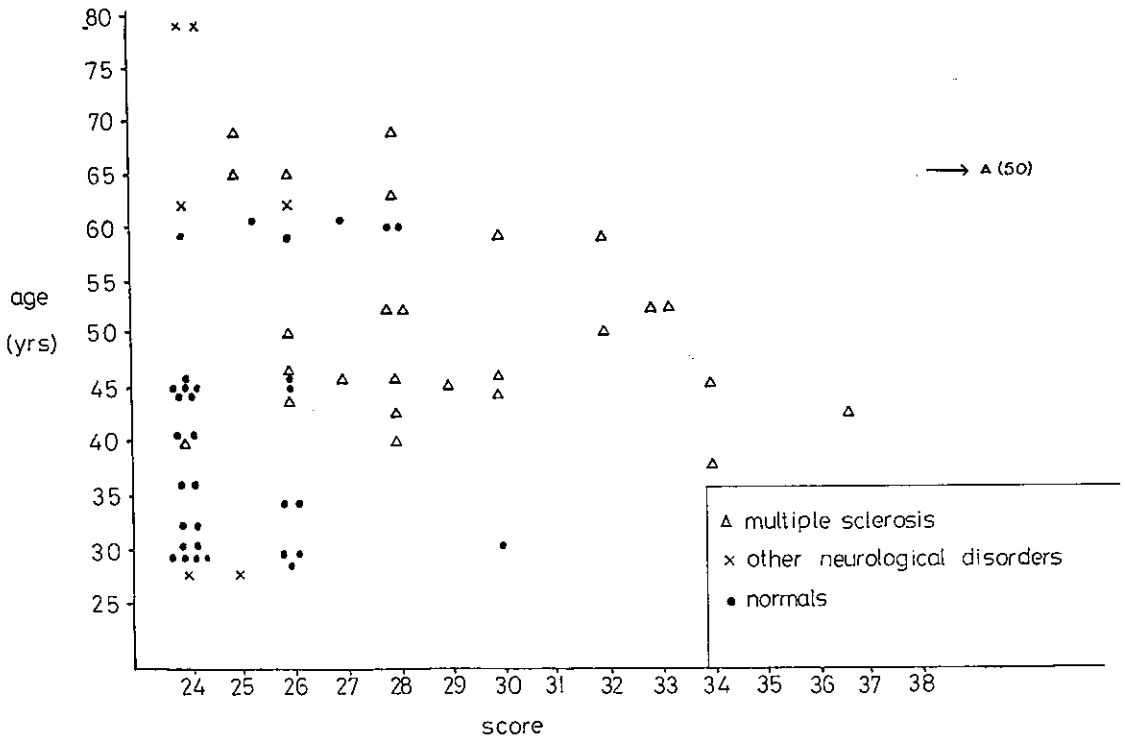

Figure 1: Graph showing scores of normals, MS group and those with other neurological disorders.

finest gratings (1 to 8), set B the medium gratings (9 to 16) and set C the widest gratings (17 to 24).

Two groups were studied. The first group consisted of sixteen randomly selected normal subjects whose ages ranged from 28 to 61 years.

The second group of 18 subjects was tested at the Multiple Sclerosis Society of N.S.W. at Chatswood. Their ages ranged from 27 to 80 years. Of this group only 15 actually had MS, whilst three had other neurological disorders, i.e. two with spinocerebellar degeneration and one with muscular dystrophy. These three were included in the study as their physical limitations were very similar to those of the MS subjects i.e. mobility disorders requiring wheelchairs or sticks, because of some muscular weakness.

For most subjects, visual acuity for near (Snellen's equivalent) was 6/9 or better. Three eyes had acuity of 6/60 or less and were not tested. Four eyes had acuity of 6/18, and for these cases the test proceeded from the threshold grating, and the final score was adjusted accordingly. This ensured that all subjects could see the stripes so that any anomalies could not be attributed simply to poor visual acuity.

The eyes were tested monocularly with reading glasses worn. The discs were presented, one group (A, B then C) at a time, in a scattered pattern on a flat table 40 cm from the eyes. The subject was requested to rearrange them in the correct order, from the finest to the broadest in the set. The test was repeated for each set. Good lighting was necessary, and the subjects were allowed a short rest between eyes.

It was found to be very important not to ask or answer leading questions and to ensure that all subjects maintained the correct test distance. In particular, the plates could not be picked up to be compared.

When the subject had ordered the plates within a reasonable time (allowing for the motor problems of the affected group) the numbers on the

back of the plates were recorded. The difference between each plate and its preceding number was used as a score, so that for each set of eight plates eight would be a perfect score, making a perfect score of 24 for the whole test. Obviously, with any errors, the score would be larger.

RESULTS (see Figure 1)

Of the normal group (32 eyes), 19 had a perfect score of 24, 12 scored at 28 or below and one scored 30. All approached the test with ease and organised the plates quickly. The mean score for this group was 25.6

Of the second group, three of the 30 MS eyes were not tested due to poor visual acuity. Of the remaining 27, only one had a perfect score, four scored below 28, 21 scored from 28 to 34 and one subject scored 50. The mean score for this group was 29.68. There was no apparent difference in the performances for sets A, B or C.

The means for each group were found to be significantly different, $t = 4.566$ ($p < 0.001$).

Apart from the larger scores, the reaction of the MS subjects was notable. Most showed a marked degree of confusion although they understood the instructions clearly. They were much slower than the normal group and became frustrated as they knew something was wrong but could not say where. To ensure that this confusion related to the spatial frequency ordering, rather than general confusion, several of the MS group were shown the plates upside down, and asked to order them in correct numerical order. All did this with ease.

All three of the subjects with other neurological disorders scored 26 or below. Despite the similarity in motility problems, they approached the test with confidence and finished it quickly.

DISCUSSION

This simple test did show a significant difference between the two groups, indicating that the MS subjects had problems with spatial frequency discrimination, quite apart from contrast sensitivity defects.

The problems of the MS group seemed to relate to the organisation of the gratings rather than poor resolution. For example, if they were asked to pick out the finest grating, then the next, and so on, most would have completed the task fairly accurately. It was the problems which arose from arranging the eight together which was most evident.

Because of the nature of the group studied (i.e. from the MS Society) all of those affected were at a moderately to severely advanced level of the disease. One obvious indication is to repeat the test on subjects with suspected or recently diagnosed MS and it is planned to do this in the future. However, it is emphasised that the test is quite simple to construct and perform and it is hoped that others may also assess its use with similar subjects.

ACKNOWLEDGEMENT

We are grateful to Jane Scroope of the Multiple Sclerosis Society of N.S.W. Chatswood for her valued assistance in this project.

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THE EFFECT OF A READING EFFICIENCY PROGRAM ON VISUALLY IMPAIRED TERTIARY STUDENTS—A PILOT STUDY

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Abstract

The aim of the pilot study was to determine if reading and vision training could improve the reading efficiency of a visually impaired person. Vision training included eccentric viewing techniques and maintenance of the eyes at null point where appropriate. Training was given in the use of lighting, reading boards and low vision aids. Exercises were given to increase the field of fixation and improve concentration. The program was found to be of benefit to the students who participated.

Key words: *Vision training, eccentric viewing, null point.*

Visual training programs to help people with visual impairment to maximize the use of their residual vision have been found to be successful both within Australia and overseas. Fridal, Jansen and Klindt[1] cite the case of partially sighted students with reasonable vision experiencing reading difficulties. A course to develop reading efficiency was shown to help these students. Moore[2] notes that visual efficiency may be learned and may be of significant value in enabling patients to get the optimum benefit from low vision aids. Inde[3] notes that once programs were introduced into Sweden, their success in rehabilitation of partially sighted persons is indicated by their expansion into the major hospitals of every country.

One form of visual efficiency training is the use of an eccentric fixation point in the presence of a central scotoma. Goodrich and Quillman[4] outline a variety of such techniques. The therapist must know the patient's visual acuity and visual field to attempt to enforce an eccentric point as close to the fovea as possible. Further methods of eccentric viewing training have been described by Lederer and Wulff[5] and Wellington.[6] In all cases the need to begin with easy tasks to help master the technique is emphasised. Only when the patient is in control of one task should the difficulty be increased and much verbal encouragement is necessary.

Visual efficiency training may also be helpful to nystagmus patients. In this case the patient is required, with the aid of the therapist, to find the null point. The use of this type of vision training in relation to reading efficiency is described by Inde.[3]

John Keast was awarded a Churchill Fellowship in 1981 to study teaching methods for the visually impaired. The study was conducted at the Royal Victorian Institute for the Blind, 557 St. Kilda Road, Melbourne, Vic. 3000.

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Following one of the author's (J. Keast) visit to the Low Vision Training School in Stockholm, Sweden, where the program outlined by Backman and Inde[7] is in use, the following course was evolved to determine if a program of visual and reading efficiency will enable a visually impaired person to make better use of their residual vision in relation to reading efficiency.

METHOD

Subjects: Students were drawn from the Tertiary Resources Service of the Royal Victorian Institute for the Blind. A group of ten tertiary students were chosen for the pilot program on a volunteer basis, after attending a seminar describing the program at the Low Vision Training School, Stockholm. The students varied in age, type of tertiary course, level of course and type of eye problem.

Apparatus: Lighting equipment provided consisted of—Planet Ibis F 20w fluorescent lamps with daylight, cool white and warm white fluorescent tubes.

Planet Ibis TFT 2 × 15 fluorescent lamps with two daylight, cool white and warm white fluorescent tubes.

Planet Designer Z incandescent lamps with 100w hot spot globe and dimmer attachment.

Reading boards were Luxo Superholder 1001 with table clamp attachment and air pressure foot pedal to control movement of the line guide.

Visual testing equipment consisted of a Bjerrum one metre field screen and targets, the Farnsworth Panel D-15 colour vision test, a Snellens distance vision chart and Faculty of Ophthalmologist near vision chart. Both large print playing cards and Field Discovery think link word cards.

The location where the program was conducted provided good daylighting and adequate space to allow free movement of the therapist around the student.

Procedure: Following selection one student chose not to continue, the remaining underwent a thorough ophthalmological examination and were then placed into one of four categories:

(a) central scotoma
(b) nystagmus
(c) peripheral scotoma
(d) dense amblyopia due to neglected strabismus (the other eye being no longer viable) or due to high myopia, diabetic retinopathy.

Students attended for a one hour session twice weekly, these sessions being run on a one to one basis with student and therapist. The program ran over a minimum of 15 sessions to a maximum of 22 depending on participants' needs.

Each student was required to do the Co-operative Reading Comprehension Test form M available from ACER, Hawthorn, Victoria (1970). Following the pre test each student was assessed for visual acuity under the working conditions, colour vision and a Bjerrum field was charted for those in the central and peripheral scotoma categories. Students in the nystagmus category were assessed by following a fixation target into the cardinal positions of gaze to determine the null point of their nystagmus. Lighting

TABLE 1
Comparison of Pre and Post Test Results

Student	Vocabulary % completed		Comprehension % completed		Comprehension % correct	
	Pre	Post	Pre	Post	Pre	Post
1	75	80	38	53	83	78
2	100	100	65	85	63	70
3	43	53	15	33	100	85
4	100	100	85	100	75	73
5	85	100	53	78	73	63
6	100	100	60	78	93	85
7	80	100	53	70	73	83

TABLE 2
Comparison of reading speed. Tests 1, 2 and 3

Student	Reading speed words/minute per test		
	1	2	3
1	55	57	71
2	144	125	147
3	40	55	56
4	195	166	158
5	160	135	162
6	145	130	145
7	133	138	128

requirements were determined subjectively by the students. Low vision aids, magnifiers and magnilink were available if the students wished to use them. The students then followed the program outlined in Backman O and Inde K.[7] This program included exercises in fixation training, line changing technique and concentration. The program includes three reading tests which the students performed as they progressed. Supplementary exercises were given to re-inforce

TABLE 3
Comparison of Comprehension Results. Tests 1, 2, 3

Student	Comprehension result % correct per test		
	1	2	3
1	60	91	100
2	60	82	100
3	80	100	100
4	100	82	100
5	80	67	88
6	60	50	100
7	42	58	78

eccentric fixation and null point maintenance. Supplementary exercises were also given in the form of homework at all stages of the program. At the culmination of the training the students did a post test which was the same Co-operative Reading Comprehension Test form M.

Data was collected in the form of test results and a questionnaire on all aspects of the training.

Of the ten students, one chose not to begin due to personal commitments, one withdrew during the program to take up employment. One student has not as yet completed the program.

DISCUSSION

The aim of this pilot program was to determine if visual efficiency and reading efficiency training could improve a visually impaired student's reading efficiency.

The components chosen to indicate reading efficiency were speed of reading and comprehension of reading material. By comparison of the pre and post tests it can be seen that the reading speed of all but one of the participants on the vocabulary section increased. The one participant who is shown as remaining the same, actually completed the pre test in under the required fifteen minutes and this test was not recorded. Therefore a comparison of pre and post tests for this student was not possible. The comprehension section had a twenty-five minute time limit. None of the participants completed the test in this time at the pre test. Comparison of pre and post tests indicates all participants increased in reading speed of the comprehension section.

The three reading tests administered as a part of the training revealed an overall increase in reading speed with one student remaining the same and two showing a decrease in speed. The three tests varied in length and difficulty and as such were not a controlled measure of reading speed.

The greatest increase in reading speed was shown by the two slowest readers. This may reflect that some students were already reading at close to their maximum efficiency. These results may also be a reflection of course duration. The slowest reading students spent three months on the program and mastered the vision training techniques involved before completion of the program. The students showing a decrease in reading speed spent only two months on the program and had not completely mastered the vision training techniques involved. The need for prolonged re-inforcement in eccentric vision training is consistent with the comments of Wulff[8] and Wellington.[6] The same reinforcement appears necessary to those students learning to maintain their eyes at the null point.

The comprehension component as tested by the pre and post tests indicated an overall

decrease in comprehension with only two students showing improvement. The three reading tests indicated an overall improvement in comprehension. The lack of improvement between the pre and post tests may have been due to students concentration on maintaining their vision technique whilst reading as quickly as possible. Extension of the program so that vision techniques become automatic is desirable, followed by a further re-assessment of both speed and comprehension. The improvement in comprehension shown by the three reading tests may have been due to the students' skills at anticipating the questions. The comprehension questions of each test were of a similar bias.

The reading efficiency of visually impaired students was able to be improved in terms of reading speed following reading and vision training. This is consistent with the results of Fridal, Jansen and Klindt.[1]

Components of the program that were not objectively measured but were revealed subjectively to be of great benefit should also be discussed.

The following is a summary of responses to a questionnaire administered to the students at the conclusion of the program.

1. Lighting: All but one student chose a reading lamp to suit their needs. One student found the 2×15w cool white fluorescent satisfactory but preferred to work with the natural lighting within the room. None of the students had been aware of the type of lighting available before the program or how to combine background and lamp lighting. All students indicated they would like to continue using the lighting provided by the program for their studies, leisure or work.
2. Reading Boards: All of the students found the reading boards were useful aids. Particular reference was made to increased comfort in the reading position, especially alleviation of back and neck cramps. The reading boards allowed easy placing of material so that the student could sit comfortably and place the reading material in the best position for them to see it, i.e. in the position of gaze of the null point, to allow maximum use of restricted field of vision. Most of the students were unaware of the existence of the boards before the program and all indicated they would like to continue using one.
3. Vision Training and Explanation: Five of the seven students were required to learn a new technique to maximize use of their residual vision. One student used an eccentric fixing technique in relation to central scotoma. The remaining four students had nystagmus and therefore needed to maintain their eyes at the null point. The student with the central scotoma was aware of using an eccentric point before the program, however this student felt she was using this technique more effectively after the program. This student was able to identify words within the reading material more accurately and was also applying the technique to her general environment quite successfully. Two of the students with nystagmus were placing material so that their eyes approached the null point, however they were unaware that they were doing this. The other two with nystagmus were not aware of this technique but at the completion of the program were able to place their eyes at the null point and were aware of the difference in the clarity of their vision with their eyes still.

All of the participants felt the time spent, in careful explanation of their eye problems in relation to the vision techniques and reading techniques they were to use, was essential.

This pilot program has demonstrated that it is possible to improve the reading efficiency of visually impaired tertiary students. Such a program could be applied with some modification to primary and secondary level students. The vision training aspects of the program could also be applied to leisure activities, general mobility, the work place and daily living skills.

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VISION DEFECTS IN DOWN'S SYNDROME AT NEWCASTLE SCHOOL FOR SPECIFIC PURPOSES

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Abstract

Nineteen mongoloid children of the 64 pupils attending Newcastle School for Specific Purposes were screened for visual acuity, muscle balance and stereoacuity. Results show a high proportion of children with poor visual acuity, possible refractive error, esotropia, and very few with good stereo vision. Those children who had the advantage of corrective glasses appeared to have more useful visual function in terms of acuity, muscle balance and stereopsis. Regular screening and early intervention with correction of visual defects may be of value to such groups to allow each child the opportunity to reach his or her full potential.

Key words: *Mongolism, screening, visual acuity, esotropia, stereoacuity, glasses.*

INTRODUCTION

Down's syndrome is a genetic defect and is the most common serious developmental problem seen in the newborn. The child has potential but this is limited and has been so from the very beginning of that pregnancy. "At risk" pregnancies are now screened for this defect so that affected parents may have counselling and possible termination of that pregnancy. Down's syndrome is a genetic imbalance where there is an extra set of genes on an extra chromosome, i.e. there are 47 chromosomes instead of 46 in every cell in the body. An average of one in 640 births has Down's syndrome. The risk increases progressively with the mother's age. It can occur in any family, any race and any social class.[1]

The old term "mongolism" for this condition is misleading and is not now used. In 1866 Langdon Down, an English physician first described the clinical features of this syndrome which now bears his name. These features include slanting of the palpebral fissure, blepharitis, epicanthal folds, esotropia, cataracts and nystagmus. True nystagmus of central origin is infrequent, but that which is seen is usually due to ocular defects. The incidence of esotropia is high—about 40%—and Brushfield spots may occur in up to 85% of cases.[2]

Many studies have reported a high incidence of eye defects in retarded children and have supported the view that persons who have experience in examining eye defects have been more successful than others in screening visual function in these children.[3-12] The school authorities at the Newcastle School for Specific Purposes were keen to supplement the existing vision screening of their pupils when this project on Down's syndrome children was proposed.

The Newcastle School for Specific Purposes is run by the N.S.W. Department of Education for pupils with various handicaps who fit into the 35-55 I.Q. bracket. These classes for retarded children are known as OF classes and at this school there are 64 pupils with ages ranging between 8 and 18 years.

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TABLE 1
General Presenting Features in 64 Children at N.S.S.P.

Slow development	10
Down's syndrome	19
Epilepsy	10
Cerebral palsy	7
Hydrocephalus	3
Diabetes, autism, hypoglycaemia, hypocalcaemia, Huntington's chorea (1 each)	5
Unknown	10
Total	64

Down's syndrome 27%

Examination of the school records shows that 27% of the enrolment has Down's syndrome. Slow development, epilepsy and "unknown" (each 15.6%) were the other main reasons given to the school as the possible cause of the retardation (Table 1).

Information about vision on the report cards is usually only an estimate of visual acuity where the child has been able to co-operate with the standard tests, and the teachers at the Newcastle School for Specific Purposes were keen to know what the visual status of each of their pupils was and whether it could be improved. It is the 27% of the children who have Down's syndrome who are the subject of this paper.

MATERIAL AND METHOD

Visual screening involved tests of visual acuity, ocular muscle balance and binocular function. All tests were chosen so that the children could understand what was required and tests were geared to the level of comprehension and ability of each child. No child failed to co-operate in each of the three systems tested. By this means a reasonably accurate estimate of the child's visual status was possible.

There were 9 males and 10 female Down's syndrome children aged between 8 and 18 years among the 64 pupils enrolled at the school. This group of 19 pupils has been divided into 8 to 12 year old and 13 to 18 year old groups. Although the older age group may be High School age they do not learn at High School level. Nevertheless it may be useful to study them in these age groups as visual development is tapering off between 8 and 12 years and should be reasonably stabilised after 12 years of age except perhaps in cases of myopia.

TABLE 2
Down's Syndrome Pupils

	Total	8-12 years	13-18 years
Male	9	7	2
Female	10	2	8
Total	19	9	10

Visual acuity was tested using a Snellen's letter chart at 6 m for the older children. The younger children used the Illiterate 'E' at 6 m. But some (two in the younger group and one in the older group) were unable to manage the latter and were tested with the Catford Visual Acuity Drum at ½ m (this may have been some advantage to a myopic subject).

Ocular movements were tested in the usual way using an interesting target. Cover test was performed for near and distance, again using interesting targets.

Binocular function was tested using the TNO Stereo Test (with red and green goggles) and the new Lang Stereotest (no filters necessary).

RESULTS

Visual acuity test results were divided into four categories:

Satisfactory	6/9 in both eyes or better
Unsatisfactory A	6/9 one eye <6/9 other eye
Unsatisfactory B	<6/9-6/60 in one or both eyes
Unsatisfactory C	<6/60 in one or both eyes

Of the 12 pupils wearing glasses, six were hypermetropic, four had hypermetropic astigmatism, only one was myopic and one had myopic astigmatism.

More pupils were wearing glasses in the younger age group and more younger children had better visual acuity than the older children.

Of three children who had satisfactory visual acuity in the younger age group, one was straight and the other two had a variable esotropia.

Ocular muscle balance was tested by observing the pattern of movement of the two eyes in the nine cardinal positions of gaze. Only one child showed a defect on this test—overaction of the

TABLE 3
Results of Visual Acuity Test

	Total	Satisfactory	Unsatisfactory		
			A	B	C
8-12 years	9 (8)	3 (3)	5 (5)	1 (0)	0
13-18 years	10 (4)	0	4 (2)	5 (2)	1
	19	3	9	6	1

Number wearing glasses in parentheses.

inferior oblique in a child in the younger age group with satisfactory (6/9BE) visual acuity and variable esotropia. Cover test for near and distance was used to ascertain the nature of the ocular muscle balance. This was defined as eso', exo' or straight (E, X, O. See table 4).

The one pupil with exotropia wore glasses for marked myopic astigmatism and could control her deviation at near. She comes into the "Unsatisfactory A" visual acuity group. Both children in the older age group who were straight were amblyopic and did not wear glasses.

Screening of binocular function was carried out using the new Lang Stereotest which does not require the wearing of dissociating filters to achieve disparity of the retinal images. If useful binocular vision (with stereopsis) exists, the lifted up pictures of a cat, a car and a star are immediately apparent to the viewer of the random dot pattern. The TNO test also depicts a random dot pattern but red/green filters have to be used to produce the binocular disparity pattern. The children seemed to prefer viewing the TNO test.

TABLE 4
Results of Cover Test

	Total	E	X	O
8-12 years	9	7 (6)	0 (0)	2 (2)
13-18 years	10	7 (3)	1 (1)	2 (0)
	19	14	1	4

Number wearing glasses in parentheses.
E = eso. X = exo. O = straight.

Perhaps this was because even if they were not binocular they could still see something which gave them a feeling of participating in the "game". Both these tests operate for near vision and are testing stereoacuity as distinct from global stereopsis which was not subject to screening in this study. The Lang test showed greater differentiation of positive versus negative results in both age groups whereas the TNO allowed more quantification of the middle range results.

TABLE 5
Results of Binocular Tests

	Total	Lang			TNO		
		Good	Some	-ve	Good	Some	-ve
8-12 yrs	9	3 (2)	2 (2)	4 (4)	1 (1)	5 (4)	3 (3)
13-18 yrs	10	1 (1)	0	9 (3)	0	4 (2)	6 (2)
	19	4	2	13	1	9	9

Number wearing glasses in parentheses.

The Lang test appears to be a more definitive screening type test although no proper comparison of these two tests is valid in such a small sample. Nevertheless, it can be seen that whichever test was used the children in the younger group appeared to have more useful binocular function for near and this group also had a greater number wearing glasses.

DISCUSSION

If we look at Tables 3, 4 and 5 it is clear that the children in the younger age group have better visual acuity and better binocular function than those in the older age group. However the incidence of esotropia is about the same in each group. It should also be noted that more of the younger children are wearing glasses and indeed seem happy to do so. Very few children have a satisfactory visual performance and those who have, have worn glasses for some years and have had regular eye treatment. Another factor which may prove relevant, is that all the younger children live at home whereas at least half of the older group have been (and are) cared for in an

institution. They have only recently been attending the Newcastle School for Specific Purposes.

The American Academy of Ophthalmology recommends vision screening and considers it to be the most important factor in the eye health care equation.[13] They estimate that 80% of learning during the first 12 years of life is through seeing.[14] The visual screening of physically and/or mentally handicapped children by suitably trained people is desirable,[4,8,9,11] in view of the high incidence of visual defects in such children.[3,7,10,15,16,17] It has been recommended that all Paediatric Assessment Centres should offer a full ophthalmological and orthoptic examination as part of their programme.[3,5,6,8,10]

Children with Down's syndrome are a special subgroup of those who are mentally retarded and present with an even higher incidence of visual defects especially of strabismus.[2,10,18] We should initiate adequate screening programmes and follow up eye treatment facilities for this group. At present these children are greatly deprived and they cannot fit into the regular system. Edwards[7] goes further and puts forward a plea for routine full ophthalmological examination for all mentally retarded children because the ocular defects of many of them would otherwise go unrecognised and untreated. This study supports this view.

It seems clear that more should be done to treat visual dysfunction as early as possible. Esotropia, visual acuity defects and anomalies of binocular function are obviously inter-related, and each factor should receive adequate treatment as early as possible. Not only will the child benefit from seeing better but he will also fit into the community more easily. As a result there should be a more effective use of public resources.

Small though this group is, it vividly illustrates the hidden deprivation Down's syndrome children suffer due to unrecognised ocular and binocular weaknesses. The greater lack of correction of visual defects in the older group may indicate a tendency to accept a lower standard of achievement as the child matures in other ways. Whatever the reasons, there appears to be ample room for improvement in the visual care of these Down's syndrome children.

ACKNOWLEDGEMENTS

I would especially like to thank Professor B. Fenelon and Miss Julianna Sidonio who were responsible for initiating this project. I would also like to thank Mr J. Metcalfe (Principal), Miss J. Bignell, Mrs J. Pryde, and the staff of the Newcastle School for Specific Purposes for their valuable help and co-operation. My thanks are also due to the staff of the Medical Communications Unit, Royal Newcastle Hospital and Faculty of Medicine, University of Newcastle, who prepared the illustrations. Last but not least I owe thanks to Mrs Pauline Black for her expert secretarial help in typing this manuscript.

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ACQUIRED BROWN'S SYNDROME: A CASE REPORT*

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Abstract

A case of Brown's syndrome occurring with chronic systemic juvenile rheumatoid arthritis is presented. The patient, a nine year old child, had a sudden onset of diplopia in dextro-elevation occurring simultaneously with a severe inflammatory attack involving several limb joints. He received systemic anti-inflammatory medication which improved his general condition, and coincided with the Brown's syndrome being resolved within three weeks without any specific ocular treatment.

It is suggested that tenosynovitis, which is commonly a feature of juvenile rheumatoid arthritis (JRA), may have been the cause of this patient's Brown's syndrome.

It is recommended that a thorough assessment of ocular motility be included in the ophthalmic examination of young children with JRA.

Key words: *Chronic systemic juvenile rheumatoid arthritis, superior oblique tendon sheath syndrome, pseudoparalysis of the inferior oblique muscle, tenosynovitis, polyarticular arthritis.*

INTRODUCTION

Brown's syndrome may be described as a mechanical limitation of elevation in adduction, of one or both eyes, due to a congenital[1-5] or acquired[3-7] defect of the superior oblique tendon, and/or its sheath. Resolution[8,9] and recurrences[3,6,7] have been reported in both congenital and acquired cases.

This paper presents a case history of acute Brown's syndrome in a child with chronic systemic juvenile rheumatoid arthritis (CSJRA).

Iritis and iridocyclitis are the usual ophthalmic disorders associated with rheumatoid arthritis.[10] Smith,[3] Scott and Knapp,[4] Terrell,[6] and Beck and Hickling,[7] however, have reported acute Brown's syndrome occurring in patients with rheumatoid arthritis.

CASE HISTORY

A nine year old boy was diagnosed as having CSJRA in February 1983. At this time he had a papular rash on his hands, arms, legs and lower abdomen, slight fever and stiffness of the limb joints.

In April 1983, he was admitted to hospital with swollen metatarsals, a painful right ankle and knees which showed bilateral popliteal fullness with tender left popliteal fossa and limitation of flexion and extension. He also had tender temporo-mandibular joints, shoulders, elbows and wrists.

Three days after admission, the patient reported seeing double when he looked up to the right.

An ocular motility examination at this time revealed the following:

*This paper was awarded The Emmie Russell Prize for 1983.

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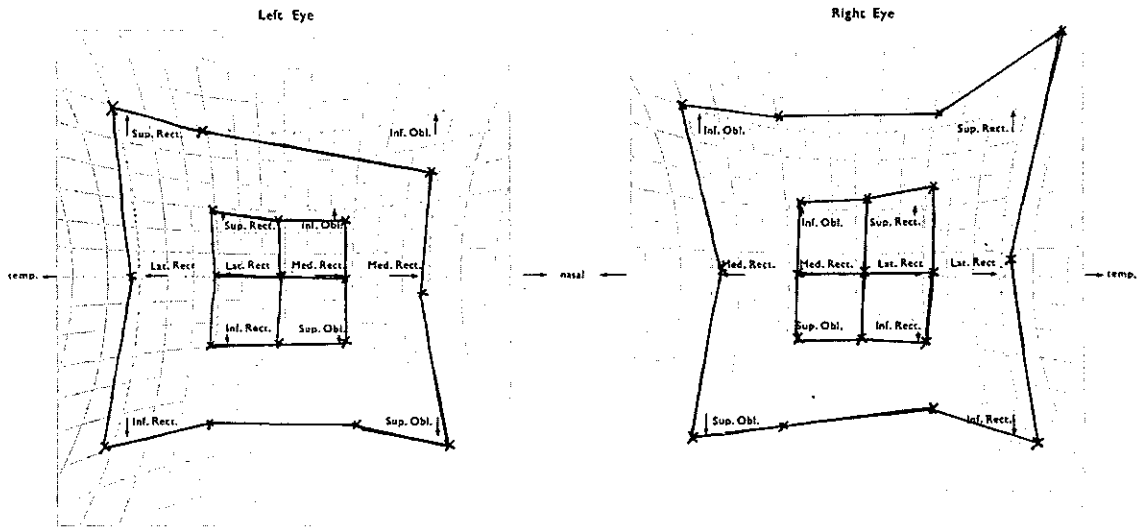

Figure 1: Hess chart showing restriction of the left inferior oblique muscle.

Abnormal head posture: slight elevation of the chin, face turn left, head tilt right.

Cover test 1/3 m: small exophoria with rapid recovery.

Cover test 6 m: orthophoria.

Ocular movements: limitation of elevation in adduction of the left eye, with a corresponding overaction of the right superior rectus.

Visual acuity: right and left = 6/5, N5

One week later a Hess chart was plotted showing a pattern of eye movements typical of Brown's syndrome (Figure 1).

An ophthalmic assessment was also performed. Fundi and media were normal, with no significant refractive error. Palpation of the orbital area above the medial canthus, in the region of the trochlea, revealed no sign of swelling. No tenderness of the area was reported.

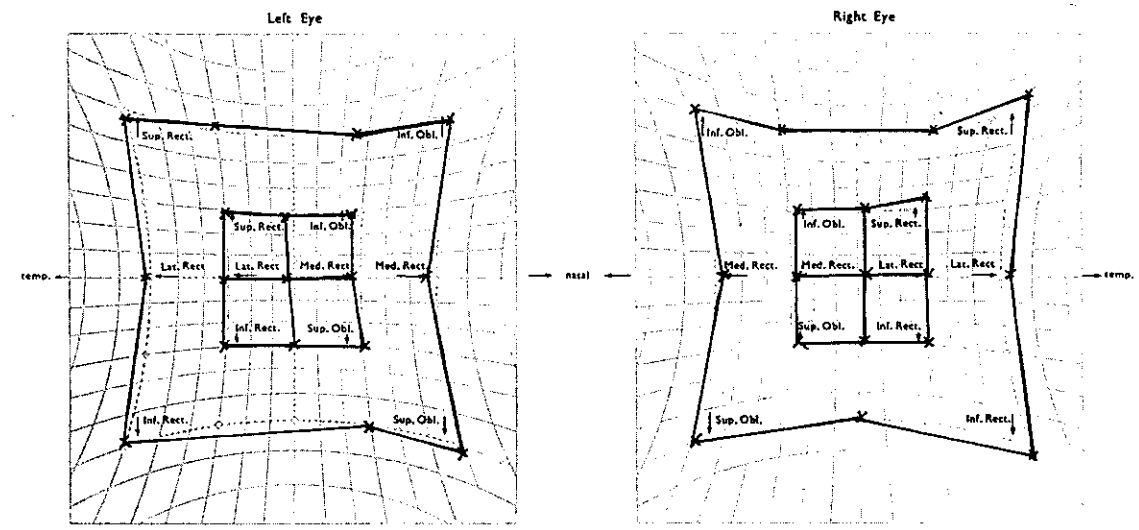

Figure 2: Hess chart showing improvement of left inferior oblique action following systemic treatment for JRA.

A stethoscope was used in an attempt to identify a clicking sound or sensation, which may have suggested the presence of a nodule on the tendon. No such sound was identified nor was a clicking sensation reported by the patient.

Systemic treatment consisted of prednisolone (dosage of 10 mg alternating with 2.5 mg per day); naprosyn (125 mg every 12 hours); and atoxiprin (900 mg every six hours). No specific ocular treatment was given.

Seven days later, the patient's ocular symptoms had significantly diminished: he complained of diplopia only on extremes of dextro-elevation. On examination, there was only a very slight restriction of elevation in adduction of the left eye (Figure 2).

The patient was discharged 16 days after admission. At this time the eye condition seemed to have resolved. There was no abnormal head posture, he had a full range of eye movements and he had no pain or diplopia on dextro-elevation.

DISCUSSION

Juvenile rheumatoid arthritis (JRA), one of fifty or more types of arthritis, is a disease that not only causes swelling and injury to the joints but affects many other parts of the body as well.[1] Our patient was diagnosed as having systemic onset JRA which occurs in about thirty percent of JRA patients and may be characterised by high fever, a rheumatoid rash, polyarticular arthritis, heart, liver, spleen and lymph node involvement and occasionally iridocyclitis.[1] Systemic onset JRA differs from Still's Disease, which is a pauciarticular type of JRA, in that the latter is characterised by having fewer than five joints involved and by having iritis as a common finding.

Tenosynovitis (i.e. frequent inflammation, or involvement of the tendon sheaths of the muscles) may also accompany JRA.[1] Both Mein[5] and Sandford-Smith[2] have postulated stenosing tenosynovitis as a cause of Brown's syndrome. The anti-inflammatory medication administered to our patient relieved the tenosynovitis (as well as the other symptoms and signs of JRA), at the same time as the Brown's syndrome resolved. We suggest, therefore, that tenosynovitis induced Brown's syndrome in our patient.

There are several differences between this patient and those discussed in previous reports of Brown's syndrome occurring in association with arthritis.[2-4] Earlier studies report patients as being adults whose arthritic condition was long-standing. Their ocular motility defects persisted for a much longer period of time, and in some cases, the eye condition was noted to recur—the recurrences coinciding with inflammatory attacks. In most cases, both the general and the ocular condition proved to be difficult to control with medication.

In contrast, our patient was nine years old. After the commencement of antiflammatory treatment, his general as well as his ocular condition improved. The limitation of elevation in adduction of the left eye had almost resolved two weeks after the onset of ocular symptoms. However, because recurrence has been noted in other cases, the possibility of Brown's syndrome recurring has been an important consideration for our patient's long-term management.

CONCLUSION

Iritis and iridocyclitis should not be the only ocular complications to be considered in the investigation of children with JRA. Assessment of the extra-ocular muscle movements should form an important part of the ophthalmic examination.

ACKNOWLEDGEMENTS

We thank Mr B. Cook and The Royal Alexandra Hospital for Children Departments of Ophthalmology, Immunology and Photography for their help and support.

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COMBINED INTERNUCLEAR OPHTHALMOPLEGIA AND CONTRALATERAL SUPERIOR OBLIQUE PALSY: A CASE REPORT

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IAN C. FRANCIS FRACS, FRACO
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Abstract

Although the fourth cranial (trochlear) nerve nucleus and the medial longitudinal fasciculus are anatomically closely associated, discrete lesions affecting both of these structures would appear to be rare. A case is presented of a man with a left internuclear ophthalmoplegia and a right fourth nerve palsy following a mild CVA.

Key words: *Internuclear ophthalmoplegia, fourth cranial nerve palsy, brain stem lesion.*

The fourth cranial (trochlear) nerve nucleus lies ventral to the Sylvian aqueduct and just dorsal to the medial longitudinal fasciculus at the level of the inferior colliculus.

The fascicular portion of the nerve passes laterally and backwards around the aqueduct and crosses the midline behind the aqueduct to emerge on the surface of the midbrain below the inferior colliculus (see Figure 1). Thus a lesion of the nucleus or its fasciculus would result in a paresis of the contralateral superior oblique.

The medial longitudinal fasciculus (MLF) is located dorsally on either side of the median line in the brain stem and consists of fibres extending from the cervical cord to the rostral midbrain. Excitatory impulses from the paramedian pontine reticular formation (horizontal gaze centre) cross and ascend in the contralateral MLF, so that the lateral rectus of one eye contracts at the same time as the medial rectus of the other eye (see Figure 2). A lesion of the MLF between the midpons and the oculomotor nucleus typically results in the classic signs of an internuclear ophthalmoplegia i.e. defective adduction of the ipsilateral eye, normal convergence and abducting nystagmus of the contralateral eye.

Although the fourth cranial nerve and the MLF are closely associated, discrete lesions affecting these structures together would appear to be rare. The following case, however, appears to illustrate such a lesion.

S.T., a 68 year old man, presented at the Casualty Department of Concord Hospital, with a history of an onset of diplopia looking forward or to the right. It was associated with veering to the right, a temporary loss of consciousness and collapse. He had a dull headache but no other neurological signs. He had a previous history of hypertension and had been on aldomet.

He was admitted to hospital for observation, but no other neurological signs, other than his diplopia, were found. He was discharged two weeks later with his diplopia improved, but still present to the right. When reviewed in the Eye Clinic one month later he had a poorly controlled

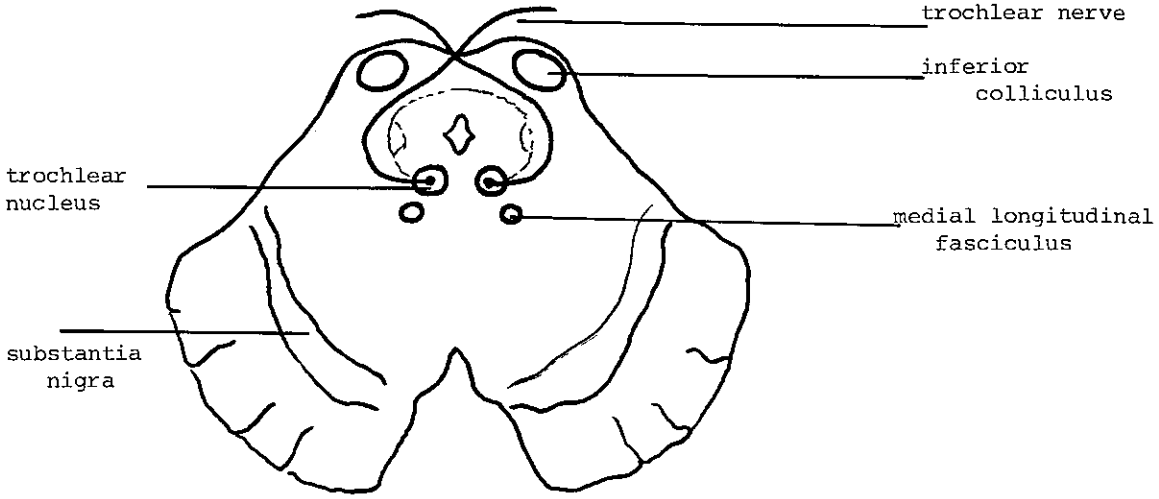

Figure 1: Cross section of the midbrain at the level of the inferior colliculus to show the nucleus and course of the fourth (trochlear) nerve and its relationship to the medial longitudinal fasciculus.

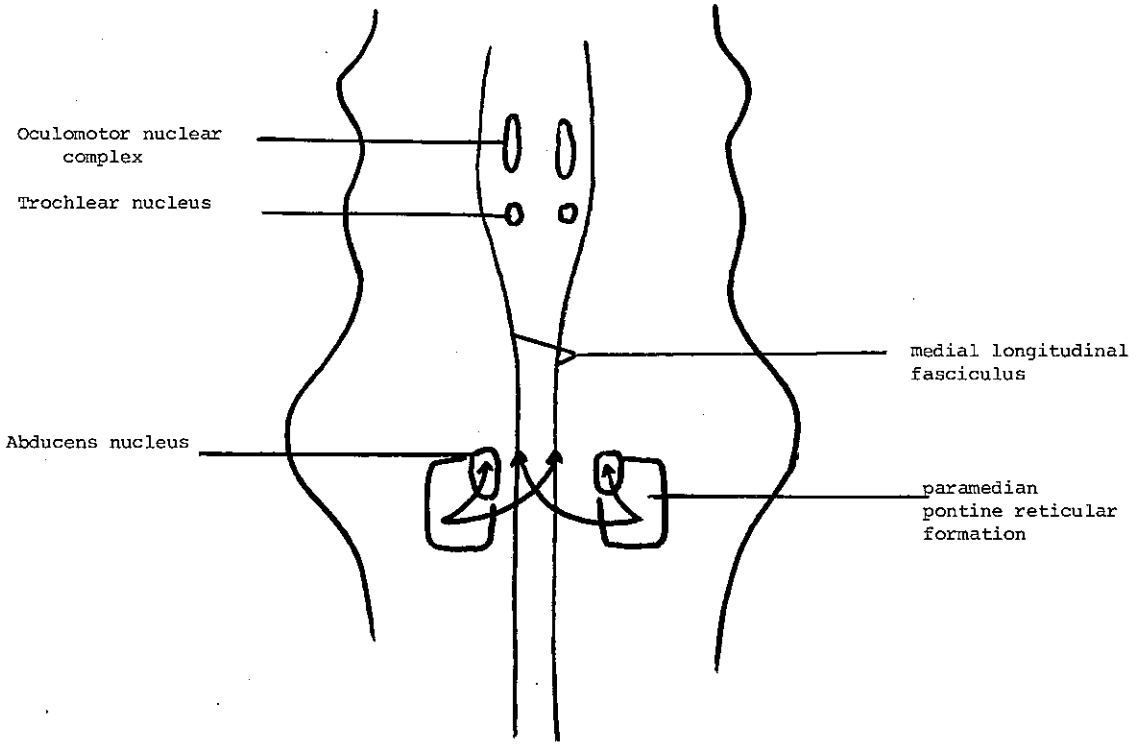

Figure 2: Diagrammatic representation of the ocular motor nuclei in the brain stem and the MLF. Impulses to initiate horizontal gaze arise in the PPRF and pass to the ipsilateral abducens nucleus, and also cross to the contralateral MLF to travel to the oculomotor nucleus.

exophoria in the primary position at distance and near which readily decompensated to a right exotropia with diplopia. He reported horizontal diplopia looking to the right, and vertical diplopia looking to the left. Examination of his extraocular muscle balance revealed slightly defective adduction of the left eye, abducting nystagmus of the right eye, normal convergence and a mild underaction of his right superior oblique. This, and the following measurements are consistent with a diagnosis of a lesion involving the left MLF and the left fourth nerve nucleus.

Neurological investigation included a CAT scan which revealed mild cerebral atrophy with no evidence of intracerebral or intracranial abnormality. However, brain stem auditory evoked potentials indicated a bilateral brain stem conduction disturbance. The patient's diplopia resolved sufficiently to be of little trouble to him, although clinical evidence of it was still present when he was last seen four months after its onset.

Prism cover test		Dextro version	Primary position	Laevo version
33 cm	FR	$-\ 6^{\Delta}\ \frac{R}{L}\ 3^{\Delta}$	$-3^{\Delta}\ \frac{R}{L}\ 4^{\Delta}$	$\phi\ \frac{R}{L}\ 7^{\Delta}$
	FL	$-10^{\Delta}\ \frac{R}{L}\ 3^{\Delta}$	$-4^{\Delta}\ \frac{R}{L}\ 3^{\Delta}$	$\phi\ \frac{R}{L}\ 4^{\Delta}$
6 m	FR	$\phi\ \frac{R}{L}\ 2^{\Delta}$	$\phi\ \frac{R}{L}\ 3^{\Delta}$	$\phi\ \frac{R}{L}\ 3^{\Delta}$
	FL	$\phi\ \frac{R}{L}\ 1^{\Delta}$	$\phi\ \frac{R}{L}\ 2^{\Delta}$	$\phi\ \frac{R}{L}\ 2^{\Delta}$

Head Tilting Test		Tilt R	Tilt L
(6 m)	FR	$\frac{R}{L}\ 8^{\Delta}$	$\frac{R}{L}\ 1^{\Delta}$
	FL	$\frac{R}{L}\ 5^{\Delta}$	θ

Synoptophore

$0\ \frac{R}{L}\ 1^{\Delta}$	$0\ \frac{R}{L}\ 1^{\Delta}$	$\oplus$ / $+2^{\circ}\ \theta$
to right←		→to left
$0\ \frac{R}{L}\ 2^{\Delta}$	$+2^{\circ}\ \frac{R}{L}\ 5^{\Delta}$	$+3\ \theta$ / $+6^{\circ}\ \frac{R}{L}\ 4^{\Delta}$

LE Fixing RE Fixing

This case is presented to alert examiners to the possibility of a contralateral fourth nerve paresis in the presence of an internuclear ophthalmoplegia. In fact, the presence of a superior oblique palsy was not initially diagnosed in this case until a full examination of ocular motility was carried out. Mild underactions of the superior oblique are not always revealed unless they are specifically looked for, especially if there is a more obvious clinical sign as there was in this case.

BOOK REVIEWS

FUNDAMENTALS OF OCULAR MOTILITY & STRABISMUS

ROBERT T. DALE
Grune & Stratton NY 1982. Price: $111.15

The last decade has seen few new books in basic ocular motility despite the huge advances in research and knowledge. Dale's new book will hopefully bridge the gap between earlier basic texts on ocular motility and the esoteric findings of the new breed of ocular "motricists" and ocular "motricity".

Dale is a neurologist and takes a slightly different viewpoint to that of the ophthalmologist.

In his preface, Dale speaks of the incorporation of a number of other fields in ocular motility and strabismus, these being "neurology, neurophysiology, mechanical engineering, electrical engineering, neuro-ophthalmology, neurosurgery, behavioural psychology, electrophysiology, histochemistry and electron microscopy".

"Fundamentals of Ocular Motility and Strabismus" then takes the reader through the anatomy and physiology of the extraocular muscles to normal binocular vision and physiology and neuro anatomy of eye movements, with a minimum of extraneous detail. All chapters are well illustrated.

There is an excellent chapter on "Sensory Defence Mechanisms" which leads on to amblyopia. This section is up to date and includes a summary of recent work on pathophysiology, especially that of Hubel and Wiesel. Later chapters deal in a more conservative fashion with strabismus in all its manifestations from definition through to an extensive but coherent review of treatment. There is a very concise and readable section on DVD.

A final chapter on surgical principles includes some of the more recent procedures such as those of Knapp, Faden and Jensen. This is followed by several appendices in the form of lists which would be very useful to orthoptic students: strabismus evaluation, the use of prisms, and diplopia fields. Dale's book has been designated as meeting the criteria for the Physician's Recognition Award of the American Medical Association and has some 52 questions at the back for self-assessment. With its concise chapters, relative lack of jargon and up to date reference list (more than 500) this book will appeal to the student as well as the graduate orthoptist.

Anne Hughes

ORTHOPTICS AND OCULAR EXAMINATION TECHNIQUES

W. E. SCOTT
D. D. D'AGOSTINO
L. W. LENNARSON
Williams & Wilkins, Baltimore/London.
Distributed in Australia by ANZ Book Company. Price: $90.00 approx.

The scope of orthoptics and the training of orthoptists over at least the past decade has so expanded that today's orthoptist is equipped with the knowledge and skills to be involved in many aspects of ophthalmology. Nevertheless, most orthoptists still see themselves as primarily skilled in the assessment and, where appropriate, the non surgical treatment of squint and other disorders of binocular vision.

However, many texts have not dealt with both the breadth and depth of knowledge required by today's orthoptist. Those written for ophthalmic assistants have not always adequately covered the basic sciences, and frequently cover squint assessment only superficially. Those on squint and related disorders are often written primarily for ophthalmologists, emphasing surgical management but not orthoptic treatment.

Therefore it is very welcome to find a new, comprehensive text which covers so much of this required knowledge, and in such detail. "Orthoptics and Ocular Examination Techniques" has been written specifically as a text for the Basic Science Course in Orthoptics and Ocular Examination Techniques hosted by the University of Iowa Department of Ophthalmology.

It is impressive in its scope, with sections covering Basic Science, Vision and Vision Assessment, Ophthalmic Skills and Equipment (including Visual Fields, Contact Lenses, Photography, Principles of Asepsis and Operating Room Procedures), Strabismus, Ocular Disorders, the Eye and the Central Nervous System, and Dyslexia. This breadth is achieved partly by having each chapter written by a specialist in that field. Perhaps an inevitable consequence of this is that there will be some overlap and even some contradictions. For example, in chapter 19 the 'average' AC/A ratio is given as 3.5, whereas in chapter 20 the 'normal' ratio is said to be 'equal to the I.P.D. in cm.' (i.e. approximately six.)

These kinds of issues can be easily resolved by the experienced orthoptist, but may be confusing for the student. The quality of some of the photographs is disappointing, and some people, especially students, may be dissuaded by the cost—approximately $90.00.

Nevertheless, the book will prove to be very valuable, not only to the student but also particularly to the orthoptist whose experience or training has not included the additional ophthalmic techniques or who has been out of the workforce for some time.

Indeed the goal stated in the preface, to 'compile a manual to serve the education needs for all related fields of ophthalmology' has been admirably achieved.

Elaine Cornell

ABSTRACTS OF STUDENT PAPERS

N.S.W.

The following are abstracts of research papers by third year orthoptic students at Cumberland College of Health Sciences, N.S.W. Copies of particular papers of interest may be obtained by writing to:
The School of Orthoptics,
Cumberland College of Health Sciences,
P.O. Box 170.
Lidcombe, N.S.W. 2141.

ORTHOPTICS AND AUTISM—**Susan Davenport**

Thirty-nine autistic children from the Forestville School were screened for ocular anomalies. Results showed an incidence of 18% of strabismus, and no other major ocular problems.

Suggestions are made for the most appropriate methods of orthoptically assessing the autistic child, and two interesting case histories are presented.

DOES AGE AFFECT THE NEAR DEVIATION?—**Glenda Underwood**

A study was conducted on the effect of age upon the near heterophoria. One hundred and forty subjects, ranging from five to 83 years and grouped according to their age, were assessed. It was found that the near deviation remained as a small exophoria until the onset of presbyopia from where it increased significantly and continued to rise.

This tends to indicate that as a consequence of age and the associated gradual decline in accommodative amplitude, the near exophoria increase is due to the loss of accommodative convergence at ⅓ of a metre, however the increase is not as great as would be expected.

INCIDENCE OF EYE DEFECTS IN SPINALLY INJURED PATIENTS—**Donna Robb**

A neuro-orthoptic examination was carried out on 20 patients and responses to visual screening were recorded.

"Horners" signs were present in many individuals, 45% of all subjects had slight ptosis and 40% had miosis. Accommodation was better than normal with 53%, while 20% had reduced accommodation and many complained of symptoms of blurred vision especially for near. CNP was found to be further than 8 cm in 50% of those tested and in those 25% had a manifest squint for near. Some showed defective saccadic movements whilst 10% had defective pursuit movements. Five percent had poor fixation while 20% were found to have suspected drug induced nystagmus; ocular muscle anomalies were shown to be present in 45%. Visual fields were defective in 15% of these tested, 25% had a colour vision defect, and vision for near was reduced by 10%. There was no response by 25% of those tested to TNO.

Pupil responses were abnormal in 15-20% of those tested while 15% gave an unusual response to Bell's phenomenon and 5% showed defective Doll's head response.

THE VALIDITY OF THE TNO TEST IN PEOPLE WITH CONGENITAL COLOUR BLINDNESS—**Robyn Bacon**

Sixty subjects were tested to determine whether congenital colour defects affect the results gained on the TNO stereoacuity test. Thirty subjects had congenital colour defects and 30 had normal colour vision. All subjects had normal ocular alignment.

The subjects were presented with the Ishihara test, Titmus test and TNO test respectively.

The results reveal that only total colour blindness, according to Ishihara, has any affect on the responses gained on TNO.

WHAT CAN YOU SEE?—**Robyn Johnstone**

A new test for stereopsis screening in children is assessed. The stereo test of Dr Joseph Lang is based on the combination of random dots and cylindrical screens. It allows for rapid examination of stereopsis without the use of glasses and with only a minimum amount of co-operation and comprehension from the patient. The new Lang-stereotest is compared with the Wirt-Titmus test and the TNO test in children between the ages of 12 months and 12 years. Three groups of patients are assessed: a control group of patients without eye defects, microtropes and anisometropic amblyopes. It is also noted at what age the test may be carried out with accurate responses.

DOES VISUAL STATUS AFFECT VISUAL PERCEPTUAL TESTING IN DOWN'S SYNDROME—**Elisabeth Miller**

A sample of 21 Down's Syndrome children was screened to examine the hypothesis that the visual status of Down's syndrome children will affect their performance standard in perceptual testing. The results of the visual screening showed that 10 children had strabismus, and five had an uncorrected refractive error. From the sample of 21, five cases were chosen

to test the hypothesis. It was found that no improvement in performance was gained from improved visual function, as measured.

PRISM ADAPTATION IN PARKINSON'S DISEASE—**Sandra Bellato**

Ten patients (aged 60-69 years) with Parkinson's disease (ranging from moderate to severe) and orthoptically normal, underwent prism adaptation tests over a period of two hours.

Measurements of heterophorias were recorded prior to the addition of prisms, immediately with, and at 40 minutes, 80 minutes and 120 minutes of wearing, and immediately upon removal of the prisms.

The results of this study show that there is no difference in prism adaptation between this group of patients, and that of 10 neurologically normal subjects (70-79 years) previously studied. The study therefore suggests that phoria adaptation does not depend on the integrity of the nigro-striatal system.

THE EFFECT OF CONVERGENCE, STEREOPSIS AND SUPPRESSION ON RELATIVE FUSION—**Elizabeth Smith**

Relative fusion may be described as the factor that gives symptom free control of a latent deviation. If it is reduced, it leads to a symptomatic heterophoria or convergence insufficiency, or an intermittent or constant squint which in turn leads to suppression. The aim of this study is to clarify the relationship between relative fusion, convergence, BSV, as tested by stereopsis, and suppression. Thus, tests performed on participants of this study included the convergence near point (CNP) in centimetres, stereopsis in seconds of arc using the Titmus Fly test, suppression using graded synoptophore fusion slide and positive and negative relative fusion at the synoptophore.

It was found that there was a significant correlation between positive relative fusion and the standard of convergence, between CNP and stereopsis, and between positive and negative relative fusion.

SHADES OF GREY—**Anastassia Constantinidis**

The effect of age on contrast sensitivity is assessed, testing 110 normal eyes in people from 5-82 years of age.

Average scores obtained on the contrast sensitivity plates, which ranged from 0.2-6.4 cycles per cm, show that contrast sensitivity is at its peak between 16-30 years at 3.2 cycles per cm. After the age of 30 there seems to be a steady decline in the appreciation of the contrast sensitivity plates and the reasons for this are discussed. Snellens VA, though, remains at a clinically acceptable level. The importance of this alternative vision test is emphasised.

THE EFFECT OF AGEING ON THE RANGE OF CONJUGATE OCULAR MOVEMENT—**Sally Turner**

The effect of ageing on the range of conjugate ocular movement was assessed in 100 people between five and 85 years of age.

The results showed a gradual and progressive limitation in both horizontal and vertical gaze with age. The greatest limitation was noted in upward gaze, however a significant limitation was noted in horizontal vergences, with down gaze being the least affected.

Thus, age must be considered on investigation of the older patient with restricted ocular motility, so that a false diagnosis is not made.

REALIGNMENT OF CONGENITAL ESOTROPIA—**Ann Crampton**

Thirty-eight congenital esotropes who underwent initial corrective surgery prior to their second birthday were examined to determine their state of binocular function following realignment.

Thirty-nine percent were orthophoric or had intermittent deviations within six months post-operatively. Of those who were orthophoric, only one failed to develop a binocular relationship.

The majority of patients (45%) were in the group with residual esotropic angles of 10^{Δ} or greater. Eighteen percent developed DVD, 26 percent had a vertical deviation by six months of age and 60% had inferior oblique involvement.

The best age for surgical alignment was found to be between six and twelve months.

IS ARC MAINTAINED WHEN THERE IS A CHANGE IN THE ANGLE OF DEVIATION?—**Julie Hall**

Seventeen patients with esotropia and anomalous retinal correspondence (ARC) were investigated to determine whether ARC could be maintained when there was a change in the angle of the deviation. Each patient was required to have 6/9 vision or better (either eye), no vertical deviation, and a change in deviation size from six metres (6 m) to 33 cm (1.3 m). At both distances, measurements were obtained with the simultaneous prism bar test and the patients sensory state was determined with Bagolini striated glasses. The results show that harmonious ARC was maintained at both distances despite the alteration in deviation size, that is, the point of anomaly appears to change to maintain ARC. Thus ARC appears to be a plastic phenomenon.

VICTORIA

The following is a summary of a research paper by third year OR308 students at the Lincoln Institute of Health Sciences, Victoria. Copies of the paper may be obtained by writing to:

The School of Orthoptics,
Lincoln Institute of Health Sciences,
625 Swanston St.,
Carlton, Vic. 3053.

MEASUREMENT OF STRABISMUS BY HIRSCHBERG'S TEST—**Karen Gibbs, Heather Hastings, Tania Iwaniw, Mee-Kuen Leung, Jacquelyn O'Donahoo, Francine Portelli, Elizabeth Quinn, Andrea Robinson, Deirdre Watson**

Key words: *Hirschberg's corneal light reflex, prism cover test, squint.*

This research compares the reliability of Hirschberg's corneal light reflex, verified by prism cover test, as a valid method of assessing the size of a squint. The 100 subjects were chosen according to the patient's ability to co-operate, age and deviation. Results showed a high positive correlation between the two methods, leading to the conclusion that this study suggests Hirschberg's corneal light reflex is a valid method of assessing the size of the squint.

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Begin with a title page giving a title which should be concise, followed by author(s) name, degrees or qualifications, name of place or institution where work was conducted and an address for communication.

On a separate page give a brief abstract of no more than 150 words, giving specific facts, findings, conclusions or opinions. Key words (about 5) or short phrases to assist indexers in cross-indexing the article, should follow the abstract on the same sheet. Key words should not duplicate words in the title but should be mentioned in the abstract.

The text follows, each page being numbered in sequence in the top right hand corner preceded by the author(s) name.

Authors are requested not to underline any part of their work.

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Photographs should be kept to the minimum. They, and diagrams, tracings, etc., should be in clear black and white with good contrast. Lettering and figures on diagrams should be clear enough to stand reduction; Letraset or Chartpak Helvetica 8 to 12 pt. is recommended.

Illustrations and **tables** should be marked lightly in pencil on the back with an arrow indicating the top, its number (Fig. 1 or Table 1, etc.) and author(s) name. Care should be taken not to bend them in any way.

Legends or captions for illustrations should be typed with arabic numerals corresponding to the illustrations.

Papers for publication in the Australian Orthoptic Journal may be submitted to the Editor at any time up to **1ST OCTOBER** in the year prior to the next edition. This date may be extended on request to 31st October, providing an abstract of the proposed paper is received by the Editor before 1st October.

*Refer Med J Aust 1982; Dec. 11/25, or apply to the Editor for a copy.

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