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Presentation of The Emmie Russell Prize for 1984 to Miss Helen Goodacre (L.), by the President, Mrs Neryla Jolly (R.).

EDITORIAL NOTE

Orthoptics in Australia is a well established yet still expanding profession, supported by a diligent administrative body. Sometimes it is wise to pause from our scientific and administrative activities and direct questions at our profession in an objective manner.

It is therefore appropriate to preface the scientific contributions to this journal with the following article by Miss Pat Lance, whose influence on orthoptics in this country extends from the earliest years, prior to the formation of our Association, to the present day.

Margaret Doyle

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ORTHOPTICS AND PROFESSIONAL ACCOUNTABILITY

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Sooner or later the members of the orthoptic profession will have to think more seriously about the matter of professional accountability. It will be necessary to consider to whom the profession is accountable—the general public, the employer or the government. As professionals we have always considered our first obligation was to the welfare of the patient. Certainly we owe it to the general public that our standards should be as high as possible. This means continual study to keep up to date with our fast moving technology and increased knowledge of the neurological control of eye movements and binocular vision.

Those orthoptists working closely with ophthalmologists in routine clinical work or in research owe it both to the patient and their employer to be as accurate as possible in their work and to be able to maintain a good rapport with the patient. The government on the other hand is paying for orthoptic education and is subsidising hospital clinical orthoptics and will also expect high quality standards.

This seems to answer in the affirmative the question of whether accountability involves quality assurance. But how is this to be judged and implemented? Peer review has been suggested but is difficult to organise in a small profession and is difficult to accept. Is re-registration the answer? Most professionals reject the idea of fronting up for regular examinations as a way of re-registration, annual payment of registration fees, in my opinion, is just a way of obtaining revenue, it does not ensure quality maintenance, and conference attendance if not accompanied by attention and comprehension will not control quality. Meaningful continuing education whether formal or informal could be the means by which members of the profession fulfil their obligation to the public to be as proficient as possible. For some people one form of continuing education may be by achieving higher tertiary awards.

The present education of orthoptists in Australia results in the acquisition of a Diploma of Applied Science in Orthoptics (a UG2 award) and it is hoped in the near future that a UG1 Bachelor of Applied Science degree will be commenced in both Schools of Orthoptics. Thus it will be possible for these graduates to progress if desired to a PG1 post graduate diploma, either in some area of orthoptics or in some other field. Standards of tertiary education are continually being reviewed by both the colleges providing it, by appropriate government boards and by the professional bodies most concerned. External advisory committees monitor the current programmes and courses being planned for the near future. Every member of the profession should be aware of the importance of both the undergraduate and postgraduate courses under review and consider whether they are relevant for today's orthoptists.

It is not impossible to imagine that before long masters degrees in orthoptics will be planned. At present those orthoptists wishing to progress in the academic field must obtain a masters degree in some other field at another tertiary institution, i.e. a university. Orthoptists hoping to make a career in the training schools of the near future

will have to obtain masters degrees or doctorates to move up the scale through lectureships to heads of school. Most promotions will also depend on the amount of publications and research undertaken. These are also important areas for the average orthoptist to undertake if possible. The new degree course will encourage this by including more research methodology in the curriculum.

However, not all orthoptists wish to move into academia and so some other methods must be sought to assist them to maintain professional viability. Attendance and participation in conferences, seminars and special non examinable courses may be the answer. The Orthoptic Association of Australia is doing its best by running special continuing education courses at the time of each annual conference and the Cumberland College of Health Science's continuing education section combines with our state branch of the Orthoptic Association of Australia in presenting short courses in N.S.W. on subjects requested by our members. None of these include any form of testing of knowledge nor is there any peer review involved. The committees planning continuing education seminars need constant help and advice to ensure that they are providing the material required to help the practising professional remain in touch with current trends of the profession.

The difficulty in designing continuing education courses is to know at what standard to present them. In some cases members who have been away from practice for several years really need refresher courses but at present our numbers are too small for such courses to be viable. If these orthoptists are really serious about a desire to be re-educated it is possible for them to enrol as non-standard students in the School of Orthoptics, doing only the orthoptic or ophthalmology subjects required, but most reject this alternative. Others are more recent graduates who feel the need to keep up to date and who have a good basic knowledge of the subject. The problem of content of the course, whether this should be orientated towards ocular motility and binocular vision or to ophthalmology, depends upon demand.

So far I have been concerned with individual members of the profession and their own accountability. What about the profession as a whole? All health professions are under the microscope at present, the government is concerned with costs and the media have made the taxpayer aware that he has a right to some say in how his money is being spent. During a recent visit to Australia Dr William Scott said that all professions who wish to have their cut of the health cake must make sure that they are delivering the goods. He suggested that continual research and review of our work is necessary, otherwise we will be found wanting. We must justify the money being spent on our education and for our services in the community.

Our Association has done a great deal in the past few years to increase the awareness of our profession both in the eyes of government departments and the general public. Our councils are aware that they cannot slacken their efforts in these directions and members can be assured that much is being done for them; however every member of the profession should be aware of the problems that are involved and play their role in helping to raise and maintain high standards.

I have not touched on the very real problem of the legal and ethical implications of professional accountability. These include the individual's right to continued practice once a qualification has been obtained and the patient's right to insist on quality control. There are many other aspects to this problem which are frightening to consider but may have to be faced eventually. In the long run though, however much our Association does for us by improving our public image—however much our education is improved—in the final analysis it is the individual orthoptist who is responsible for his/her own professional outlook. If professionally responsible members continue to be dedicated to the concept of professional accountability and if individual orthoptists by personal continuing education achieve and maintain high standards of expertise the profession itself will be able to maintain a place in the health care system.

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THE ASSESSMENT OF VISUAL ACUITY BY THE FORCED PREFERENTIAL LOOKING METHOD

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Abstract

Forced choice preferential looking (FPL) is a behavioural method for the assessment of visual acuity in preverbal infants. Using apparatus, designed and built locally, we tested 63 babies whose ages ranged from 6 weeks to 11 months on photographically generated grating targets. We could measure binocular acuity in 51 (81%). Our results show a progressive improvement in visual acuity until approximately 6 months of age. Our results in a small number of babies older than 6 months indicate the standard FPL technique is unreliable in older babies due to inattention.

Key words: *forced choice preferential looking, visual acuity, infant.*

Forced choice preferential looking (FPL) is a non-invasive behavioural method for the assessment of vision in babies and infants. It was mainly developed by psychologists for studies into the development of vision in normal children.[1,2] Its potential use as a clinical tool is only beginning to be realised.[3-6] The method derives its name from the visual behaviour observed when a baby is presented with two objects: one patterned, the other of equal luminance but with a visually homogeneous surface. Provided that the baby can resolve the detail on the patterned object it will fixate this object in preference to the homogeneous object. This behaviour is what is observed when a child fixates its mother's face. In its simplest form a device to observe this phenomenon is seen in Figure 1.

By displaying the patterned object as a series of alternating black and white stripes (i.e. a visual grating) the child's acuity can be estimated by varying the spatial frequency of the grating until the child no longer displays a fixation preference. The last grating on which a significant fixation preference is displayed is considered to estimate the child's acuity. High contrast visual gratings can be correlated with Snellen acuities giving the clinician a more familiar measure of the child's visual performance.[1] Unfortunately, if the side on which the test grating is displayed is known to the observer, bias on the part of the observer is introduced. To get around this problem the side on which the test grating is displayed can be masked from the observer (usually by having the gratings displayed by a second person) so that

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Figure 1: The child seated in the mother's lap is fixating the grating in the observer's left hand.

the observer's judgement of whether the child is preferentially fixating a particular grating must be made solely by the child's response. The observer's choice of the child's fixation preference is then decided only by the child's response hence the name (observer's) Forced Choice (of the child's) Preferential Looking (FPL).

We have constructed apparatus to measure visual acuity in preverbal infants by the FPL method and used it to measure binocular visual acuity in a series of infants. Forced choice preferential looking is a method which can be performed easily by orthoptists, offering the possibility of a new role for the orthoptic profession in the assessment of children with visual disorders.

MATERIALS AND METHODS

Our apparatus (described in detail elsewhere)[7] is an adaptation of that developed by Dobson *et al.*[8] The apparatus consists of a panel with two 9 cm portholes placed 36 cm apart (Figure 2). The infants responses are observed via a TV monitor (Figure 3). Photographically generated visual gratings are presented in a random manner through either porthole. The presentation of the gratings is controlled by a microprocessor. The operator selects the grating size to start the test procedure. The microprocessor keeps a score of the operator's performance and provides trial by trial feedback to the operator. When statistical significance is achieved for a particular grating the microprocessor terminates the test, prints out a trial by trial score of the test and commences the next test sequence.

A minimum of five and a maximum of 20 trials are used for each grating. It is assumed that if the infant fixates the grating in 75% or more of the trials it can resolve the grating.[8] A

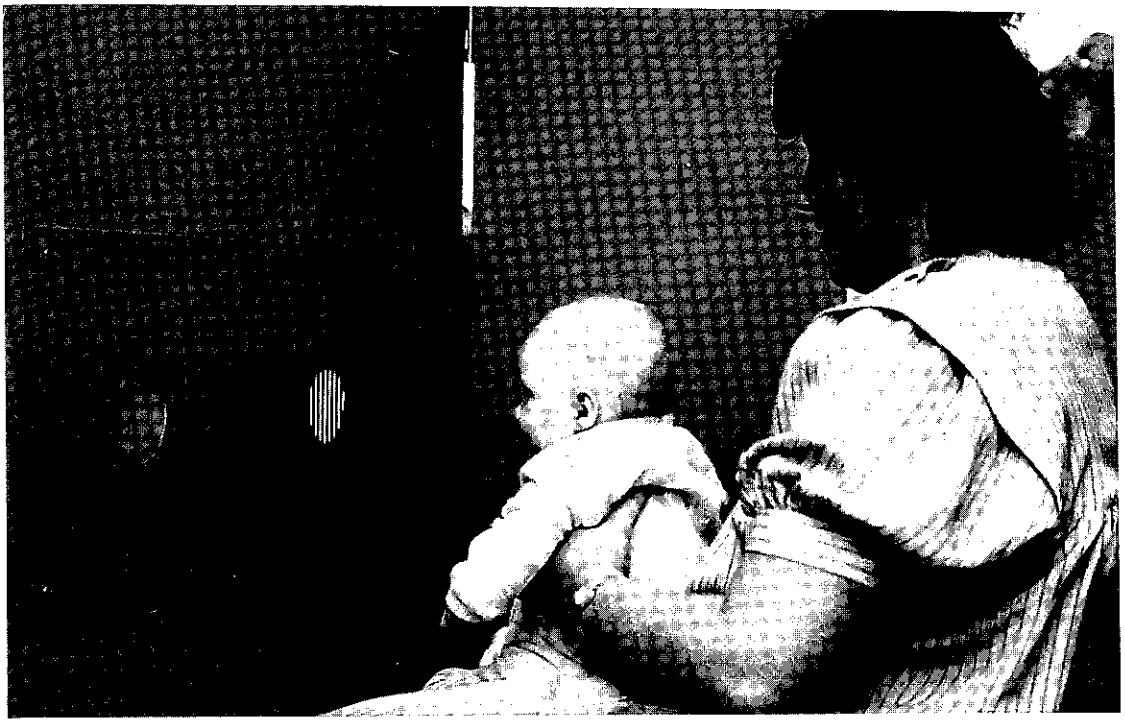

Figure 2: FPL apparatus showing a child fixating a grating displayed in the right porthole. Note the camera lens between the two portholes.

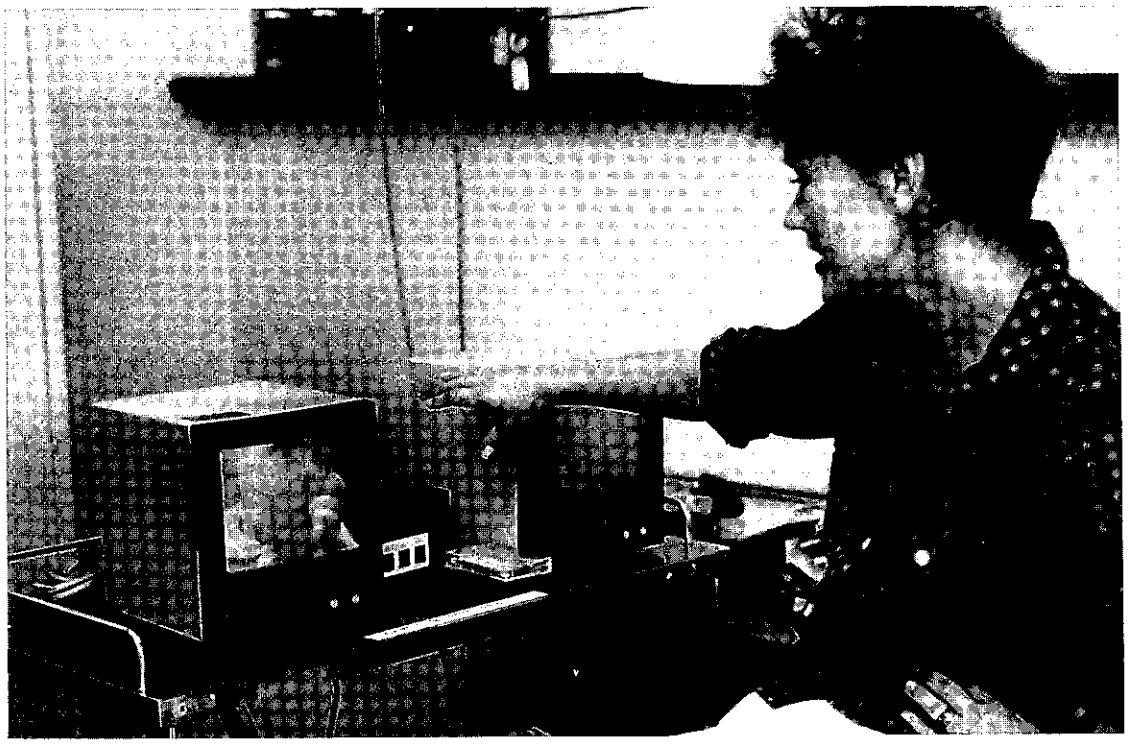

Figure 3: The observer judges the side on which the grating is displayed solely by the child's fixation preference seen on the TV monitor. The right hand TV monitor is used for programming purposes. The central panel between the monitors controls the apparatus *via* the microprocessor.

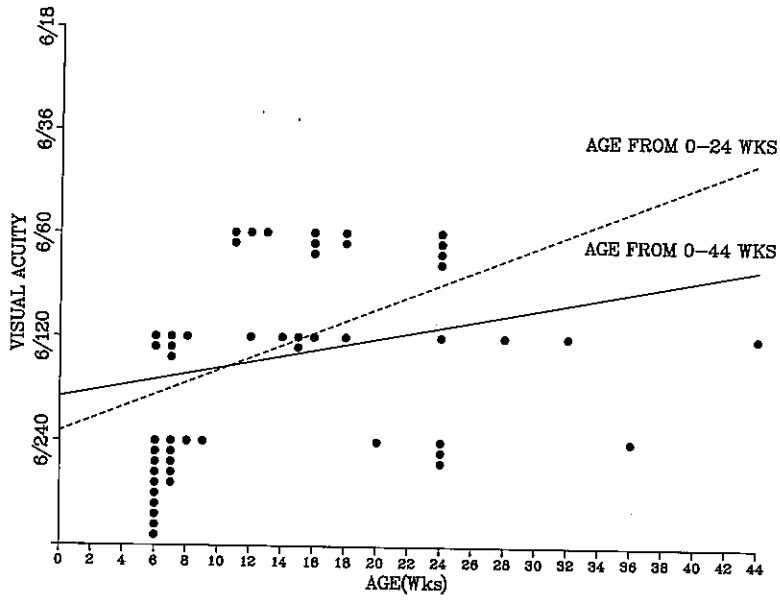

Figure 4: Binocular Visual Acuity In 51 Infants.

'staircase' testing procedure is used to enable rapid testing; i.e. each test sequence uses one grating size only. The staircase method is too time consuming to be done routinely by an ophthalmologist, therefore the role of observer is ideally suited to an orthoptist whose professional skills are well established in the assessment of infant visual behaviour.

The infant is tested with sequences of progressively smaller grating size until the acuity has been determined. In our apparatus we use gratings of 0.75, 1.5, 3, 5 and 12 cyc/deg corresponding to the Snellen acuities of 6/240, 6/120, 6/60, 6/36 and 6/18 respectively. The finest grating with which the child achieves statistical significance is taken to estimate the child's acuity. The test has been done binocularly in developmental studies but can be done monocularly to detect differences in acuity between the two eyes in infants with ocular disease.[6,9]

RESULTS

Sixty-three infants ranging in age from six weeks to 11 months have been tested. Overall we obtained a result in 51 babies (81%). The majority (31) were six to eight week old babies attending the well baby clinic for their six week postnatal checkup. The majority (22/31) of the six to eight week old babies were able to resolve a 0.75 cyc/deg grating corresponding to a Snellen acuity of 6/240 at the test distance of 35 cm. The remaining six babies in this age group resolved a grating of 1.5 cyc/deg (6/120). The data are presented in Figure 4. The test sequence usually took less than 10 minutes to complete. The main reason for failure was sleepiness on the part of the child in the younger age group. Babies over 6 months of age were too easily distracted to complete reliably the test within the time constraints imposed. The data from these older children is included in the table for completeness although there were only four children tested older than six months.

DISCUSSION

The assessment of visual performance in infants below six months of age is a common clinical problem. In our relatively inexperienced hands we have been able to use FPL to establish the

binocular visual acuity in babies six weeks to six months of age. Our results in this age range show a progressive improvement in visual acuity from six weeks to six months of age and are similar to those published elsewhere.[10] The apparent decline in acuity which we observed after six months of age we attribute to a lack of attentiveness on the child's part. The rapid improvement in visual acuity in the first six months of life (possibly due to retinal maturation) is followed by a plateau which lasts for several months. The next improvement in visual acuity which begins at about 10 months of age is then attributed to cortical maturation.[12] Whatever the explanation, older babies do poorly with the conventional FPL technique and their attention must be maintained by a stimulus-reward system in order to obtain useful results.[11]

The advantage of the FPL method is that it is non-invasive and does not require highly technical skills for its performance. As orthoptists are by the very nature of their work already familiar with work involving babies, the necessary skill for them to act as the observer comes easily. Our apparatus was designed to be 'user friendly'; all that is necessary to activate the apparatus is to load the program into the computer and start the test sequence.

The disadvantages of the FPL method are that it requires some cooperation on the part of the child (e.g. the child must be awake), and that it is usually a binocular test. These disadvantages must both be addressed. First, the state of the child's arousal is crucial. The period just after a feed before the child goes to sleep or the period just after awakening before hunger supervenes are the best times for testing. Our success rate is not much lower than that reported by others (usually of the order of 90%)[8] despite the fact that we set ourselves the task of testing the children on a tight schedule (15 minute appointments) so as to mimic the busy clinic situation. A child untestable on one occasion can always be brought back for another appointment or alternatively can be settled down in an adjacent room and retested later.

Testing monocularly can be easily achieved either by using a ping pong ball cut in half[13] as an occluder or by using a translucent patch since most infants object to being occluded by an opaque patch. A precise measurement of an infant's monocular visual acuity is particularly useful in the management of eye diseases where the eyes may be satisfactorily aligned preventing easy assessment of the child's fixation preference (e.g. congenital cataracts or anisometropia). In the immediate postoperative period it would be very useful to have a precise measure of the acuity in each eye to assess the appropriateness of patching and of a particular power contact lens. We do not have a great deal of experience with monocular use as yet but we are encouraged by our experience to date.

Even when used binocularly FPL has proved useful in the assessment of children with suspected poor sight or blindness and helps in the assessment of children with developmental delay thought to be due to poor vision.[9] FPL is too cumbersome for use as a screening tool; other methods such as photorefraction are more appropriate. Nonetheless, it should come to play a role in the assessment of individual patients with specific problems such as aphakia. Its role as a research tool for investigating normal visual development in the first few months of life by such means has influenced clinicians towards earlier intervention in such conditions as congenital cataract because it is now well accepted that a successful outcome depends on treatment within the critical period of visual development.[14]

This method is worthy of investigation especially in those teaching hospitals which train orthoptists. The orthoptic profession has an opportunity to expand its role in children's eye care by investigating this technique and its possible uses.

ACKNOWLEDGEMENTS

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of the draft manuscript of this paper. This project was supported by grants from the Channel 10 Children's Medical Research Foundation of South Australia.

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Australian Orthoptic Journal 1985; 22: 9-17

MINUS OVERCORRECTION: CONSERVATIVE TREATMENT OF INTERMITTENT EXOTROPIA IN THE YOUNG CHILD— A COMPARATIVE STUDY*

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Abstract

Minus overcorrection is examined in the treatment of children, under 6 years of age, with intermittent exotropia of the divergence excess type. Minus lenses stimulate accommodative convergence which provides a stimulus to the fusional skills required to control a divergent deviation. A group of 22 children given minus overcorrection is compared with a second group of 12 children with whom minus overcorrection was not successful and later required surgery. Average strength prescribed was −2.50 D.S.

68% of Group 1 and 62% of the total (Group 1 and Group 2) were exophoric at all distances after 12 months with overcorrection. 27% of the total also had a reduction in deviation size of ≥15$^{\Delta}$ at 6 metres. Group 1 had a significantly smaller near deviation and higher AC/A ratio than Group 2 ($p = 0.01$). It is concluded that minus overcorrection can enhance control of divergence in young children and may avoid unnecessary surgery.

Key words: *minus lenses, accommodative convergence/accommodation ratio, exophoria.*

INTRODUCTION

Satisfactory management of intermittent exotropia, X(T), in the young child under the age of six years, depends upon the prevention of suppression. Merely correcting the divergent deviation by surgery, in visual immaturity, may post-operatively lead to a recurrence of the divergent deviation or to a small angle esotropia because of the persistence of suppression.[1] Therefore nonsurgical methods of treating X(T) may be the preferred form of therapy in the young child, as this increases the time the child is bifoveal and prevents the development of suppression.

One method of nonsurgical therapy is overcorrecting the refraction with minus lenses. Minus lenses stimulate accommodation hence accommodative convergence. This initiates the convergence response which is then completed by reflex fusional vergence, hence giving added stimulus to the fusional skills required to control a divergent deviation.[2]

Merrick[3] outlined the usefulness of weak minus lenses (less than −1.25 D.S.) in older symptomatic X(T) for relieving symptoms. She also reported a case of a young X(T) who after a trial of −3.00 D.S. became convergent at the near position, and concluded that minus lenses be approached with caution and are justified only as a temporary procedure in symptomatic X(T) until an operation is possible.

Jampolsky,[4] however, notes that 3 to 5 dioptres of accommodation stimulated is well tolerated by many children.

* This paper was awarded The Emmie Russell Prize for 1984.

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In 1983[5] he reported that 72% of young children with X(T) had an improved ocular status while wearing minus lens overcorrection.

Burian[6] suggests that minus lenses are indicated temporarily in high AC/A types of X(T) but uses this form of treatment sparingly, being wary of accommodative asthenopia as the child grows older.

The literature indicates that there are differences in attitude towards minus lens overcorrection.

The purpose of this paper is to report the results of a study involving 34 children with X(T) whose initial treatment was by minus overcorrection, and to determine the variables which may influence the response to minus overcorrection.

METHOD

1. Subjects

A total of 34 subjects were first seen between 1978 and 1984. They were collected from the orthoptic records of a sponsored orthoptic practice in the Tamworth district, and in some cases the distance travelled by subjects was up to 400 km. Over 50% of the children travelled distances greater than 100 km to the clinic.

The following criteria for inclusion were used:

—acquired X(T) of divergence excess type—true or simulated

—no surgery prior to treatment with minus lenses

—less than 0.75 D.S. of anisometropia

—typical signs of divergence e.g. shutting one eye

—age or distance travelled prevented the subject from benefiting from orthoptic treatment alone.

The subjects were divided into two groups.

Group 1: consisted of 22 children (9 female, 13 male) who were given minus overcorrection as the only form of treatment.

Group 2: consisted of 12 children (4 female, 8 male) who were initially given minus lenses but later required surgery. Group 2 was included in the study to compare results with Group 1 and identify reasons for discontinuing minus overcorrection.

Age when minus overcorrection began in Group 1 ranged from 18 months to 6 years, median 3 years, and Group 2 ranged from 1 to 6 years, median four years.

2. Prescription of Minus Lenses

At the initial consultation all subjects had some form of orthoptic assessment ranging from screening tests to full assessment. Fundus and media examination and refraction were performed on all subjects. 85% had a cycloplegic refraction.

In all cases the working distance and −3.00 D.S. were subtracted from the refraction to ascertain the strength of minus lens to be prescribed; thus correcting astigmatism and small degrees of anisometropia. Initially the prescriptions ranged from a strength of −1.25 D.S. to −3.75 D.S. (averaging −2.50 D.S.).

Subjects were then monitored by ophthalmologist and orthoptist for refractive changes as well as control of deviation one to three months later, then at periods of three, six and 12 months following. Any reduction in control was adjusted by increasing the minus power, and conversely, if well controlled, power was decreased, thus exercising negative relative fusion. Throughout the study the maximum power prescribed was −5.00 D.S.

A significant shift towards myopia did not occur in subjects with minus overcorrection. Three subjects became myopic, all of whom were less hypermetropic under the original refraction.

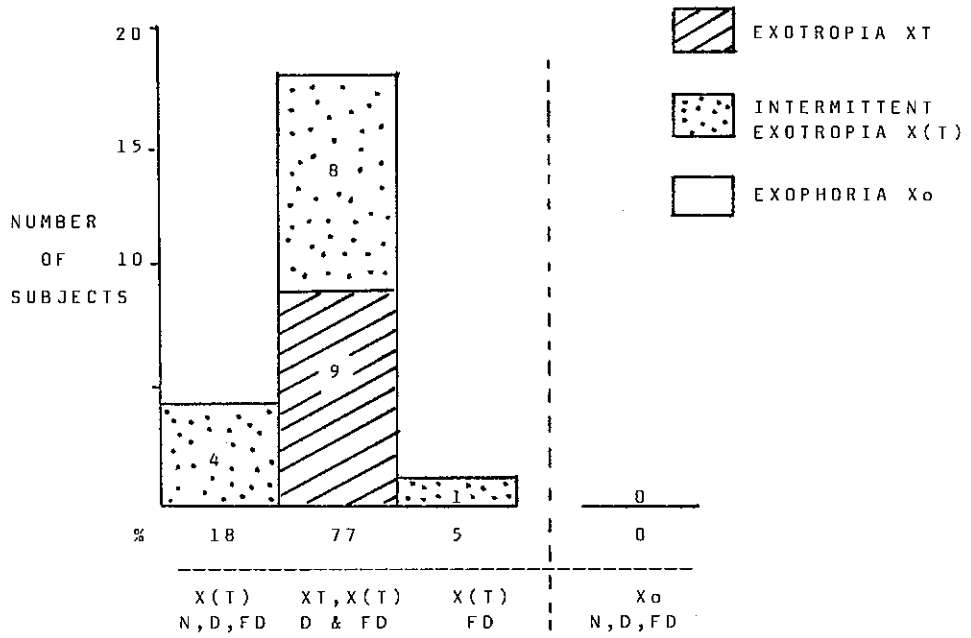
All subjects achieved vision of 6/9 or better with the minus overcorrection.

Orthoptic techniques consisting of part-time occlusion for amblyopia or elimination of suppression, pathological diplopia teaching and convergence exercises were used in conjunction with minus overcorrection to eliminate any further barriers to obtaining binocular single vision.

RESULTS

A functional cure was judged to have been achieved when an X(T) was converted to an exophoria at near, 6 metres and far distance. Degree of divergence was charted before

FIGURE 1 : GROUP 1 BEFORE MINUS OVERCORRECTION



treatment, at one to three months, six months and 12 months later with all subjects wearing initial prescription for 12 months.

(A) Group 1

Follow-up period for Group 1 ranged from five months to 67 months, with an average follow-up of 32 months.

Before treatment (Figure 1) no subject satisfied the criteria of a functional cure. 18% were becoming manifestly divergent at all distances and 77% at six metres and far distance.

After one to three months of wearing minus overcorrection full-time (Figure 2) there had already been a shift towards the functional cure; 32% actually achieving exophoria at all distances with minus overcorrection.

Six months after the commencement of therapy there has been a shift of the subjects who were intermittent at 6 metres and far distance in Figure 2, to being only intermittent in the far distance (Figure 3). Three subjects had not been followed up at this time, so percentages are of the known total of subjects.

After 12 months (Figure 4) 68% were functionally cured with minus lenses. The divergent deviation was latent at all distances indicating an improvement in fusional status whilst wearing a minus overcorrection.

Of the eight subjects with a follow-up period of greater than three years, six are now functionally cured with minus over-correction and a well controlled exophoria or X(T) without minus lenses (two moved out of the area). Of these, 4 have had minus lenses suspended altogether and control has been maintained 12 months later.

(B) Group 2

The follow-up period before surgery ranged from three to 59 months, with an average of two years before an operation.

Figure 5 shows that the pre-treatment degree of divergence in Group 2 is similar to that of Group 1.

After 12 months (Figure 6), 33% were functionally cured but later required surgery for reasons to be discussed. When Group 1 and 2

FIGURE 2 : GROUP 1 ONE TO THREE MONTHS LATER

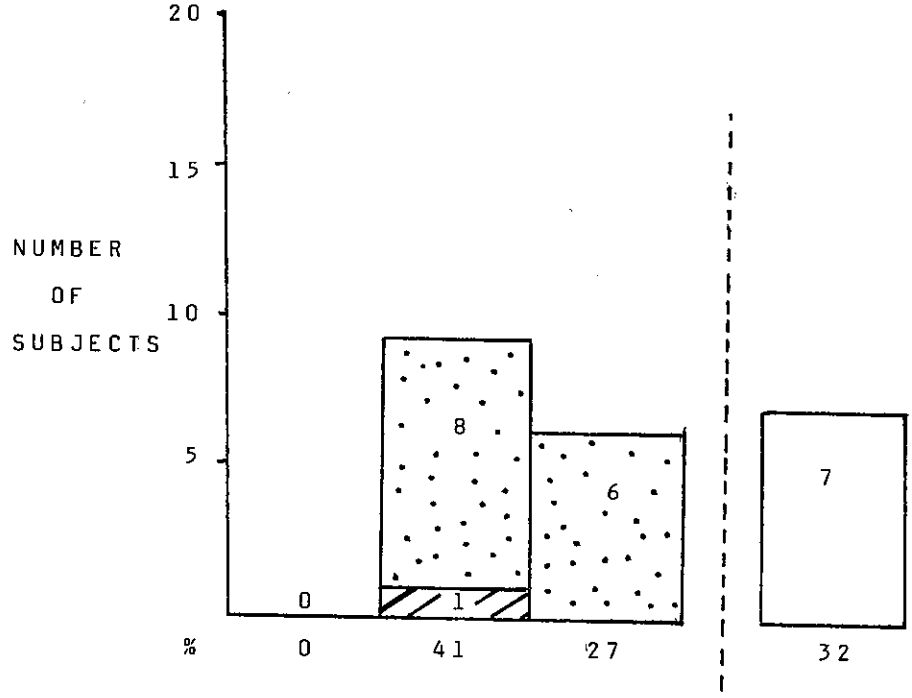


FIGURE 3 : GROUP 1 SIX MONTHS LATER

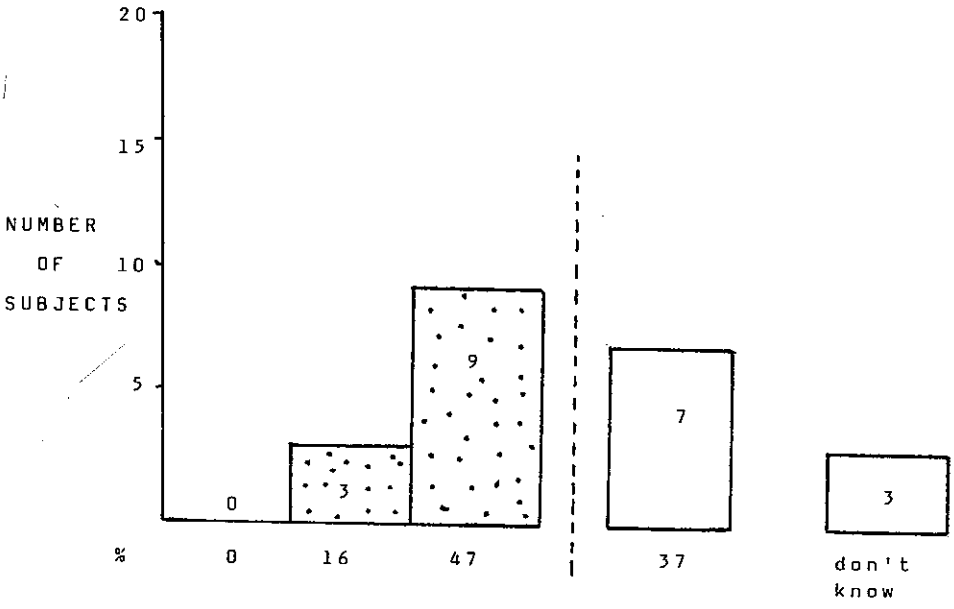


FIGURE 4 : GROUP 1 TWELVE MONTHS AFTER COMMENCEMENT OF MINUS OVERCORRECTION

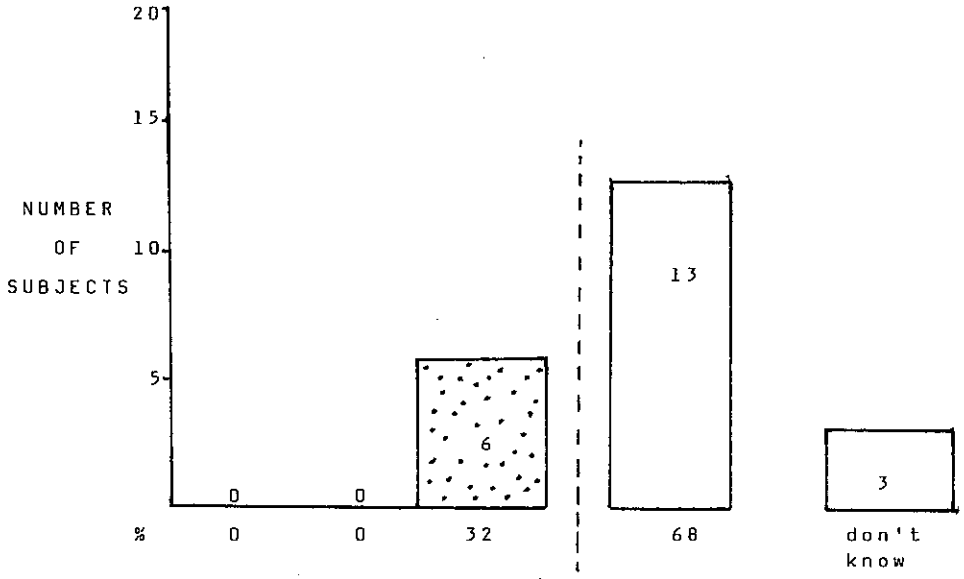


FIGURE 5 : GROUP 2 BEFORE MINUS OVERCORRECTION

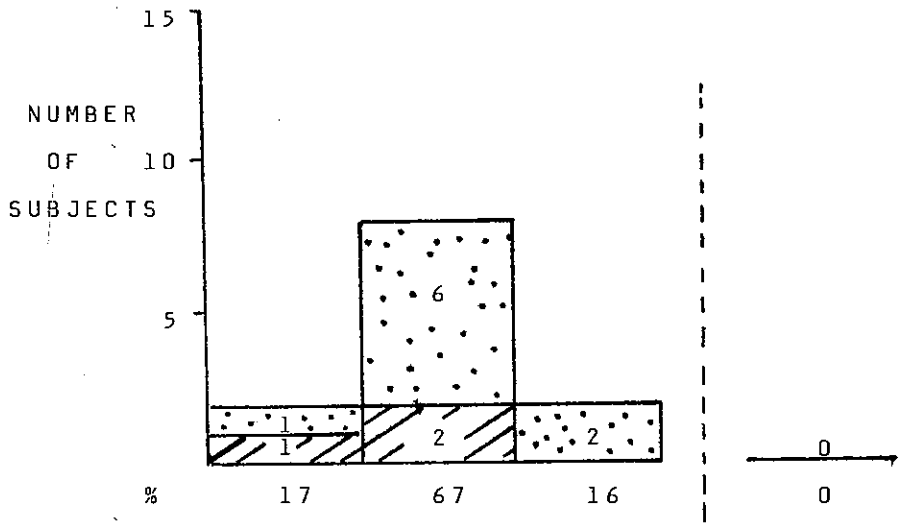
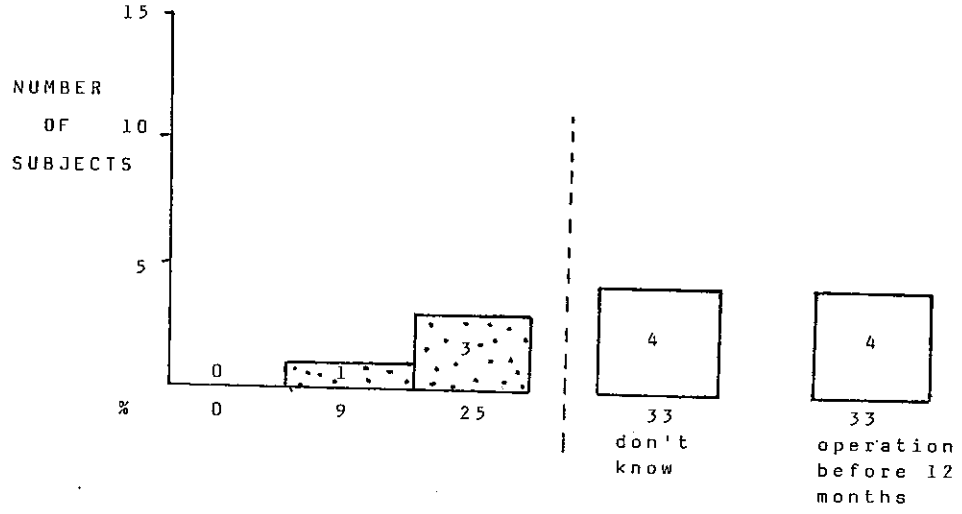


FIGURE 6 : GROUP 2 TWELVE MONTHS LATER



were compared before treatment and after 12 months there was no significant difference. (Before treatment Chi square = 1.42, after treatment Chi square = 2.53).

Reasons for discontinuing minus overcorrection were identified and divided into 2 groups:

1. Ocular
   - —strength of minus lenses increased but poor control remained, or control deteriorated despite increases in strength 3 subjects
   - —large angle: $>35^{\Delta}$ at 6 metres 3 subjects
   - —poor motor fusion 1 subject

2. Social
   - —parents wanted surgery 2 subjects
   - —behaviour problems and minus lenses not tolerated 3 subjects

(C) Group 1 and 2: Functional cure within 12 months

Combining the two groups, a total of 21 subjects (62%) became exophoric at all distances within 12 months of minus overcorrection, regardless of whether surgery was required later on.

This group was then examined to determine the frequency of quantitative reductions in deviation size. A reduction of $\geq 15^{\Delta}$ of divergence at 6 metres was considered significant. 27% of the total number of subjects not only became exophoric but also had a $\geq 15^{\Delta}$ in reduction of deviation. But 35% of the total, who were functionally cured did not have this reduction in angle size, thus indicating that achievement of exophoria could be obtained without significant reductions in deviation size (Table 1).

(D) An interesting exception

There was only one case of a child becoming convergent following minus overcorrection. C.S. was 18 months old when therapy was commenced for a 30^{Δ} X(T) at 6 metres and far distance. He became an intermittent left convergent squint after six months with minus overcorrection so a bifocal of +3.00 D.S. was

TABLE 1
Functionally Cured: Reduction in Deviation Size

	Number of Subjects	
	Group 1	Group 2
Exophoria and Angle decreased $\geq 15^{\Delta}$ at 6 m	6 (max 30^{Δ})	3 (max 22^{Δ})
Exophoria and Angle not reduced	8 (min 4^{Δ})	4 (min 0^{Δ})

TABLE 2
AC/A Ratio

	Percentage	
	Group 1	Group 2
Low AC/A ≤ 3	0	0
Normal AC/A $3 < \times \leq 6$	0	58
High AC/A >6	100	42

given at near, but was not worn correctly. After glasses were discontinued he returned to the original X(T) and surgery was performed.

Variables which may have influenced response to minus overcorrection were then compared between groups.

(1) Age:
The mean age at commencement of therapy for Group 1 was 3 years 9 months, and for Group 2, 4 years 1 month. The 't' test shows no statistical difference between groups.

(2) Pre-Treatment Size of Deviation:
The pre-treatment deviation size, in prism dioptres, at near, 6 metres and far distance was compared between the two groups. 95% of Group 1 and 50% of Group 2 had a near deviation of $\leq 24^{\Delta}$. Using Chi squared analysis, Group 1 had a significantly smaller near deviation than Group 2. (Chi = 7.37, p = 0.01) Deviation at 6 metres was $>30^{\Delta}$ in 19% of Group 1 and 33% of Group 2. When deviation at far distance was compared, 33% of Group 1 and 41% of Group 2 measured $>30^{\Delta}$. Although a greater number of children in Group 2 had large deviations, this was not statistically significant.

(3) Accommodative Convergence/Accommodation Ratio:
The accommodative convergence/accommodation ratio (AC/A ratio) was calculated to determine if response to minus overcorrection was better in subjects with a high AC/A ratio. The heterophoria method of calculation was used:

$$\text{AC/A ratio} = \frac{\frac{\text{IPD}}{\text{NFD}} + n^{\Delta} - o^{\Delta}}{D}$$

where: IPD —cms—taken from the table of averages of IPD measurements[7]
NFD—near fixation distance, 0.33 metres
n —deviation at near, in prism dioptres
o —deviation at 6 metres, in prism dioptres
D —dioptres of accommodation used in changing fixation from distance to near

An AC/A ratio of ≤ 3 was considered as low, 3 to 6 normal and >6 high. Since this study involved X(T) of the divergence excess type it was expected that most subjects would have a high AC/A ratio. Table 2 shows that in Group 1 all of the children had a high AC/A ratio, ranging from 7 to 12. In Group 2 only 42% had a high AC/A ratio. The 't' test shows that Group 1 had a significantly higher AC/A ratio ($t = 2.91$, $p = 0.01$). Of the subjects in Group 2 who had ocular reasons for discontinuing minus overcorrection, five out of seven had a normal AC/A ratio.

(4) Vertical Element:
Presence of vertical deviation was compared between the two groups. 62% of Group 1 and 52% of Group 2 had a vertical component to their deviation. Chi squared analysis, comparing the presence or absence of vertical deviation showed no difference between the two groups. Therefore, a vertical component to the deviation does not appear to prevent achievement of a functional cure.

DISCUSSION

Age of onset of X(T) is frequently within the first years of life.[5,8] Treatment at this time is restricted to patching regimes, as surgery too early increases the occurrence of esotropia and consequent reduced stereopsis. Minus over-

correction has a role in bridging this gap in management techniques.

In this study 21 children, i.e. 62% of the total, who had a poorly controlled X(T) at one or more distances, converted to an exophoria after 12 months of wearing minus lenses. This is slightly less than the 72% with a functional cure recorded by Jampolsky.[5] However, Jampolsky notes that his sample had a selection bias, because half of the children already had myopia or myopic astigmatism, and may have had better compliance with therapy.

In the past, minus lenses have been avoided because of the fear of inducing an esotropia.[3] Jampolsky[5] noted the development of a transient esophoria at the near position immediately after the initiation of minus overcorrection. This esophoria usually readjusts within a few weeks back to the original orthophoria or exophoria, suggesting plasticity of the AC/A ratio. It appears that the child will only occasionally be unable to make this adjustment and decompensate to an esotropia. Only one subject in this series, and two out of 35 in Jampolsky's study became esotropic and they all reverted back to exophoria once the minus lenses were removed. The evidence suggests that fear of inducing intractible esotropia is not justified.

It is beneficial to determine the conditions which maximize the effectiveness of minus overcorrection. Achievement of control is a gradual process and it is suggested that at least 12 months is necessary before fusional skills are sufficiently improved to convert an X(T) to an exophoria. For the majority of children a refractive overcorrection of -3.00 D.S. and up to a strength of -5.00 D.S. is well tolerated and a visual acuity of 6/9 or better achieved. As expected, subjects with a high AC/A ratio, hence small near deviations ($\leq 24^{\Delta}$), proved to benefit most from minus overcorrection, presumably because a greater convergence response is produced for each dioptre of accommodation stimulated. However, a reduction in deviation size is not necessarily required to obtain a functional cure.

Initially the aim of minus overcorrection was as a temporary method of increasing bifoveality in X(T) until the child was old enough to benefit from orthoptic techniques, or permit measurements that are accurate enough for precise surgery. However, from this study it appears that minus lenses may be used in the long term. Where control is improved sufficiently and a functional cure achieved, the strength can be reduced and minus lenses ultimately suspended without the need for surgery. A greater follow-up is necessary to determine the long-term effect of minus overcorrection on divergence. The fact that some subjects have had minus lenses suspended, with exophoria maintained, is encouraging.

CONCLUSION

Minus lenses do appear to enhance the fusional skills required to control divergence in young children. In this study 62% of the total were converted to an exophoria at all distances with minus overcorrection. Minus 3.00 D.S. of overcorrection is well tolerated. Attainment of exophoria is more likely to occur in subjects with a high AC/A ratio and a near deviation of $\leq 24^{\Delta}$. In the short term minus lenses offer a conservative approach to the treatment of X(T) in young children until surgery and conventional orthoptic exercises can be instituted. It is especially useful in cases where the child needs glasses to correct anisometropia and astigmatism, or if the child lives some distance from the clinic and consequently visits are infrequent. In the long term, it is possible that minus overcorrection can improve control of divergence sufficiently to then be ultimately suspended with exophoria maintained and surgery avoided.

ACKNOWLEDGEMENT

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DOES UHTHOFF'S SYMPTOM ALWAYS MEAN M.S.?

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Abstract

Transient visual blurring caused by raised body temperature, often related to exercise and hot baths, has become known as Uhthoff's symptom. This symptom has classically been regarded as heralding multiple sclerosis. This paper describes firstly a classical case of Uhthoff's as the presenting symptom in multiple sclerosis, secondly in pituitary adenoma and thirdly in ischaemic optic neuropathy.

In all three diagnoses the vascular—steal theory offers the most acceptable explanation as to the mechanism of this visual disturbance.

Uhthoff's often means multiple sclerosis. This paper however stresses the importance of a careful investigation that does not ignore the possibility of compressive lesions or other neurological problems in patients who present with Uhthoff's symptom.

Key words: *pituitary adenoma, ischaemic optic neuropathy, Leber's optic atrophy, multiple sclerosis.*

INTRODUCTION

Episodes of transient visual blurring caused by raised body temperature have become known as Uhthoff's symptom, or Uhthoff's sign or syndrome. Raised body temperature may occur following exercise, hot baths or even infections.

Traditionally this symptom has been linked with the diagnosis of multiple sclerosis but following the presentation of four patients with this symptom and other pathology, a literature search was made. It revealed that while most authors describe this symptom as occurring in association with retrobulbar neuritis, due to demyelination, other possible aetiological factors have also been described.

HISTORY

Uhthoff[1] first noted this symptom in 1889 in four patients, following exercise, with retrobulbar neuritis and other signs of multiple sclerosis.

Other authors confirmed these findings and in 1947 Franklin and Brickner[2] reported transient visual blurring not only after exercise but also after hot food, hot showers and even a hot hair drier. Further studies continued to confirm the association of this transient visual blurring and the optic neuritis of M.S.[3-6,9] Trials and reports have resulted in the clinician equating Uhthoff's sign with multiple sclerosis but the occasional paper has appeared which described Uhthoff's sign in patients with other conditions. In 1958 Nelson *et al.*[7] noted its occurrence in patients in whom hyperthermia was induced (Friedriech's ataxia, pituitary tumour and posterior cerebral insufficiency) but they did not report its occurrence spontaneously in these cases. Smith *et al.*[8] reconfirmed this symptom occurring in acute Leber's optic neuropathy and noted further that this had been described by Morris in 1884.

Reprints from: Miss J. Hall, Mater Hospital Eye Department, Woolloongabba, Queensland, 4102.

PATHOGENESIS

The exact cause of this visual disturbance is unknown. Nelson *et al.*,[7] who induced hyperthermia in a group of neurological patients thereby producing visual disturbances, felt there was a definite relationship between increased body temperature and the disturbance.

In the past it was suggested this change could be related to retinal vasospasm.[2] Other authors postulated alteration in the ionic disturbance in cell membranes or refractive causes.[4]

Guthrie[9] in 1951 suggested that peripheral vasodilation, associated with change in skin temperature, led to vascular changes in the central nervous system. Earl[10] (1964) postulated that these induced circulatory changes, while insufficient to affect normal neural tissue, could possibly be sufficient to affect the blood supply to areas of demyelination, resulting in reduced function.

Of all the theories advanced concerning Uhthoff's symptom this theory of vascular-steal appears to be the most favoured. It would be a suitable explanation not only for patients with multiple sclerosis but also for those with diagnoses as described in this paper.

Case Presentations:

With that background three patients are described who have been seen with Uhthoff's symptom as their presenting symptom. Each of these patients has a different diagnosis.

1. Uhthoff's symptom and multiple sclerosis.

   J.B.—a physician aged 31.

   History 1979. Disturbed (L) central vision following squash; pain on abduction of L. eye.

   Examination—V.A.—R. 6/5; L. 6/5; pupils normal; fundi: N.A.D.; field (L) temporal desaturation to red and green; marked left optic nerve conduction defect; C.T. scan—normal.

   Subsequent history. Uhthoff's and visual disturbance settled; 1981 lower limb weakness; 1983 dysaesthesia in hands; 1984 R. retrobulbar neuritis.

2. Uhthoff's symptom and pituitary tumour

   G.P. aged 29. For 18 months blurred vision; diagnosed as retrobulbar neuritis; 4 weeks pregnant; vision deteriorated with exercise or hot shower resulting in a dense central scotoma; one episode of reduced vision for 2 months; possible episode of leg weakness; family history—brother suffers M.S.

   Examination—V.A. R. 6/9 pt., L. 6/9 pt.; pupils N.A.D. fundi N.A.D.; fields equivocal; V.E.P.—grossly abnormal waveforms R. and L. were recorded. No recognisable responses for the checkerboard stimuli, confirming bilateral optic abnormality: fields repeated—bitemporal loss to red targets: C.T. scan—pituitary adenoma; surgery performed.

   Subsequent history. V.A. R. and L. 6/5; normal pregnancy; marked improvement (note Fig. 1); no further Uhthoff's; V.E.P.—improved waveform but still delayed.

3. Uhthoff's symptom and ischaemic optic neuropathy

   H.T. aged 77.

   History—blurred vision after hot baths for one to three hours; also after painting. Previous history—bilateral aphakia (15 years); left retinal detachment with massive vitreous retraction; right contact lens.

   Examination—R. 6/5 with correction; fundi N.A.D.; field N.A.D.; E.S.R. N.A.D.; V.E.P.—delayed responses.

   Presumptive diagnosis—ischaemic optic neuropathy.

   Subsequent history—aspirin b.d.; resolution of symptoms; no further Uhthoff's.

DISCUSSION

In this paper three patients' histories were detailed to demonstrate that Uhthoff's symptom may herald the diagnosis not only of multiple sclerosis and as previously described Leber's optic atrophy but also of compressive lesions of the optic nerve (pituitary adenoma) and ischaemic optic neuropathy.

The warning of Earl,[10] that this symptom deserves wider recognition to avoid the diagnosis of psychogenic disturbance in these patients, is

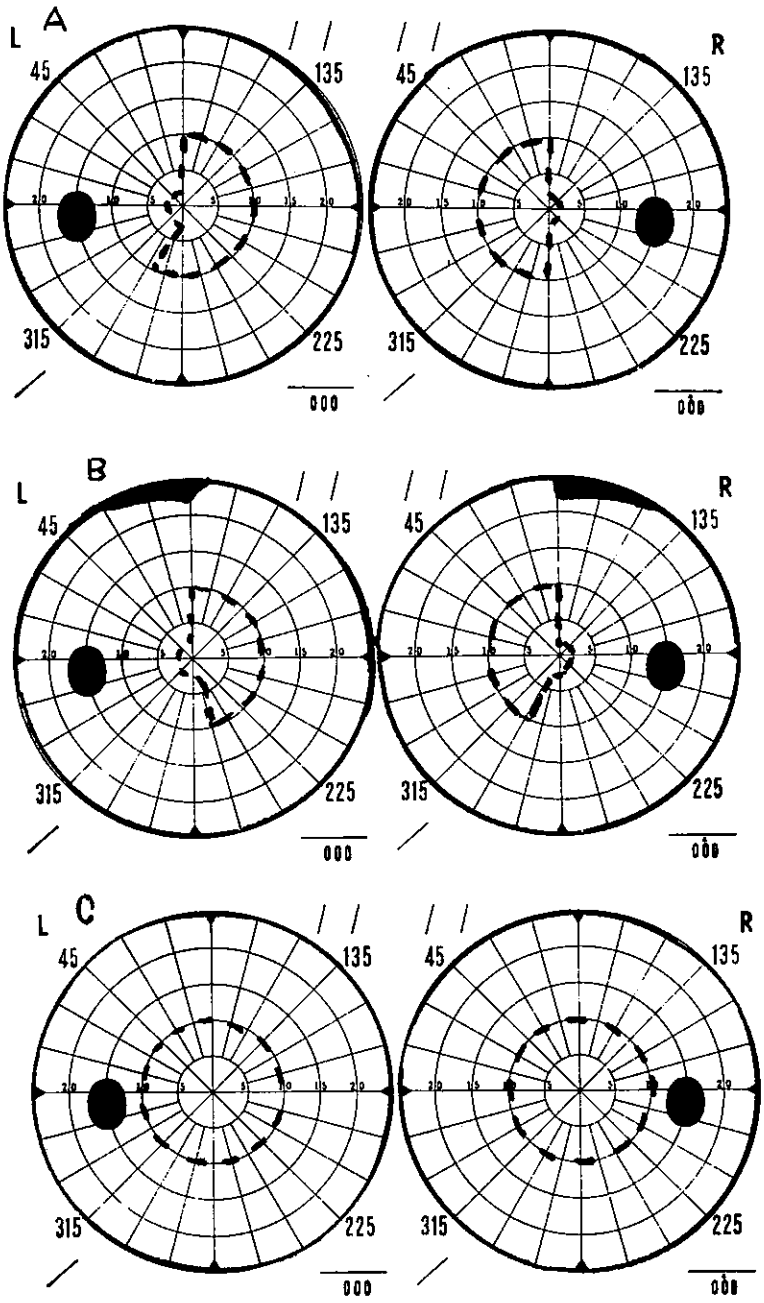

Figure 1:

Key: ———— = 10 mm white target tested at 2 m.
— — — — = 20 mm red target tested at 2 m.

A. Bitemporal field loss to red. (Patient G.P.)
B. Progression of this loss pre-operatively.
C. Normal fields post-operatively.

still valid. But this warning should be expanded so that the clinician is aware that it is not a specific indication of multiple sclerosis and that Uhthoff's symptom may indeed be indicative of other neurological disorders.

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THE USE OF VERTICAL PRISMS IN PROGRESSIVE SUPRANUCLEAR PALSY (STEELE RICHARDSON OLSZEWSKI DISEASE)

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Abstract

Progressive supranuclear palsy is a degenerative disease, ultimately resulting in total external ophthalmoplegia. Problems of down gaze palsy may be the most distressing. Two cases are presented where 15 dioptre prisms were used base down to help these symptoms.

Key words: *progressive supranuclear palsy, prism treatment.*

Progressive supranuclear palsy (Steele Richardson Olszewski disease) is a degenerative condition of the central nervous system resulting in defective and ultimately absent saccadic and smooth pursuit eye movements. It affects individuals in the sixth and seventh decade[1] and although early reports suggested that males are more affected than females, Pfaffenbach *et al.*[2] in a study of 44 cases found an almost equal sex distribution.

The earliest ocular sign is usually defective downward voluntary gaze, followed by upward and horizontal gaze defects, and paralysis of convergence. Smooth pursuit movements also become affected, resulting in a striking pattern of apparent complete external ophthalmoplegia. Optokinetic responses are usually absent. Doll's head movements can usually be demonstrated until the very late stages of the disease, however, an associated feature of the disease, neck stiffness, may make this difficult to assess.

Pfaffenbach's study found Bell's phenomenon to be absent in all 13 cases tested, and, although conjugate movements were markedly affected, only two cases out of 44 had a manifest squint.[2]

Other associated features are pseudobulbar palsy, dysarthria and, later, dysphagia and extensor posturing of the head and neck, with rubbery rigidity of the posterior cervical muscles. Progressive supranuclear palsy can be distinguished from Parkinsonism by the pattern of ophthalmoplegia, lack of tremor and the presence of pyramidal tract signs.[1] The signs are due to a progressive degeneration and gliosis of the subthalamic nuclei, substantia nigra, superior colliculi and dentate nucleus of the cerebellum, resulting within approximately five years (in the majority of cases) in dementia and death.[1]

Although there is no known treatment to affect the ultimate outcome of this disease, two patients seen at Concord Hospital have been helped by the use of base down prisms to overcome (partly) one of the main visual problems—being unable to look down. The presenting symptoms are often related to defective downward gaze because, not only is it

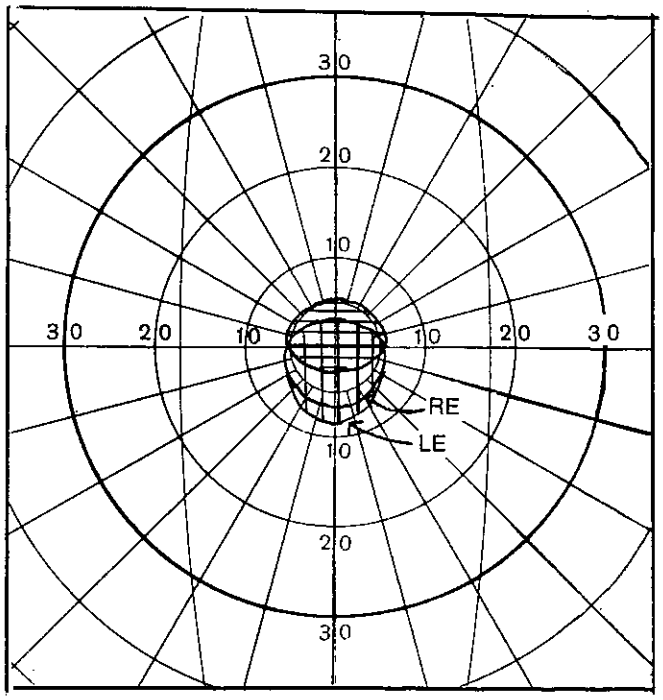

Figure 1: Field of eye movement.
Without prisms: ≡ With prisms: ||||

one of the first symptoms, it is also the most disabling when all eye movements are lost. Base down prisms (in front of each eye) have the effect of moving the whole visual field up, so that downward gaze is less required and visual performance related to objects in the patients inferior visual field is improved.

The first of the two men given this form of help, on being asked to sit down for his initial examination, missed the chair and fell over. He was found to have completely absent down gaze (saccadic and pursuit). There were no upward saccades, but some upward pursuit movements. Horizontal movements were also defective (saccades more so than pursuit) and he had no convergence. Although his neck was definitely stiff, doll's head vertical and horizontal movements could be demonstrated.

He was subsequently diagnosed as being at a moderately late stage of the disease, with consequent moderate dementia and dysphagia, so it was difficult to communicate with him. His wife, however, reported that she had to guide him virtually all the time when he was walking.

15 prism dioptre base down press on prisms were attached to his glasses, and, although he showed initial disorientation, he adjusted to them remarkably quickly. On a subsequent visit his wife commented that it had taken about half a day for him to become used to them, and she felt that they were definitely helping him.

The second man, although showing almost complete vertical gaze palsy (saccadic and pursuit), severely limited horizontal movements and moderately affected convergence, was mentally more alert and could communicate well. His main visual complaint was of being unable to read, and he also had trouble eating because of his deficient downgaze. Although he was wearing bifocals, it was considered that it was worth trying vertical prisms, again 15 prism dioptre base down either eye, were applied as press on prisms. Subjectively he reported a definite improvement, and became adjusted to

them in less than a day. Although the prisms had the effect of bringing the bifocal segment into the main field of vision and the patient reported some distortion of distance objects, he was prepared to accept this for the improvement in other visual tasks. He has had a pair of light weight reading glasses ordered with this prismatic correction incorporated.

A field of fixation was plotted for each eye using the Goldmann perimeter with the patient being asked to follow the target and report when he felt that he was no longer able to look directly at it. This was done with each eye separately as his defective convergence meant that, at the close range, the target was horizontally double.

Figure 1 shows the severe limitation of eye movements in all directions, but with the prisms allowing more direct fixation of targets on depression. It can be seen that the displacement of the visual field is only small, suggesting that prisms of greater power could perhaps be used. It is interesting to note that the amount of movement is a little better in the left eye.

This form of therapy has only been reported briefly in the literature. In Pffafenbach's study, three patients were given "special 90 degree glasses" which were reported as being "more bother than benefit". However, these were obviously much more powerful that the approximately 7 degree displacement in this study. Walsh and Hoyt[3] reported that "prisms with base down added to their reading glasses gave much relief" to two elderly males with the disease, but give no further details of the power used.

Thus, although offering only marginal help, vertical prisms do appear to be one positive way of assisting these people with down gaze palsies.

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A COMPARATIVE ASSESSMENT OF THE LANG, T.N.O. AND TITMUS STEREO TESTS

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Abstract

The Lang stereo test was assessed. This test is based on the combination of the random dot stereogram and the panagraphic technique of Hess. 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 stereo test is compared with the T.N.O. and Titmus tests in children between the ages of 3 months and 12 years of age. Four groups of children were assessed:

1. *a control group of children with no apparent ocular defects*
2. *a group of infants with no apparent ocular defects*
3. *a group of children with moderate anisometropic amblyopia*
4. *a group of children with microtropia.*

The results show that the Lang test is a superior screening test for infants; it is a comparable screening test for anisometropic amblyopia and a superior screening test for microtropia.

Key words: *Lang test, T.N.O. test, Titmus test, stereopsis, microtropia, anisometropic amblyopia, screening test.*

INTRODUCTION

"Stereopsis is the binocular perception of depth made possible by the fact that the two eyes view the external world from different vantage points, and ... (it) requires the correlation of information from the two eyes."[1]

In recent times, there have been a number of major advancements in the understanding of binocular single vision. One development has been the physiological demonstration of binocularly driven cells at the cortical level [2,3] and another, the invention of various tests designed to demonstrate the presence of stereopsis under "near normal" viewing conditions.[4]

At Sydney Eye Hospital Orthoptic Clinic, the tests most commonly used have been the Titmus and T.N.O. tests. The Titmus is designed to quantitatively elicit stereopsis. It is based on the principle of the polarised 3-D vectograph and polaroid glasses must be worn so that each eye receives only one of the two images at a time. The T.N.O. is also a quantitative test. It employs the principle of random dot stereograms and spectacles are required to isolate the images received by either eye in order that the disparity is appreciated and the test plates viewed stereoscopically. The advantage of the T.N.O. is its absence of monocular clues. While both tests are designed for children, it is our experience that they are difficult tests for those under three years, since the child has to be persuaded to wear glasses, and because a positive response requires a subjective response from the child. This is especially true of the T.N.O.

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Professor J. Lang has designed a new stereo test where spectacles are not required. In this test, a positive response can be obtained objectively by the examiner observing the child's eye movements. The Lang test combines the random dot principle of Julesz, with the panagraphic technique invented by Hess in 1912. In the test, a cat, a star and a car are seen stereoscopically on a flat screen measuring 9.5 cms × 14.5 cms. At a distance of 40 cms, the cat represents a disparity of 1,200 secs of arc, the star 600 secs of arc, and the car 550 secs of arc.[5]

Because of technical reasons, the Lang is not as suited for assessing the stereothreshold as the Titmus and T.N.O. To date, no statistics have been published, but Lang has found by experience that subjects with constant strabismus and microtropia generally fail to give a stereoscopic response, whereas subjects with moderate anisometropic amblyopia may pass the test.[6] He also found that the design permitted a reliable testing of infants under three years of age.

AIMS

The aims of this study were to:

1. ascertain the validity of Lang's statements concerning his new stereo test whereby:
   (a) subjects with a moderate degree of anisometropic amblyopia generally do give a stereoscopic response,
   (b) subjects with microtropia usually fail to give a stereoscopic response,
   (c) infants can be tested accurately
2. assess the screening effectiveness of the Lang as compared to the Titmus and T.N.O. tests.

METHOD

Eighty-four children were examined. Following orthoptic examination, the children were placed in the following categories:

Group 1 a control group of 22 children with no apparent ocular defects. They ranged in age from three to 11 years.

Group 2 12 infants with no apparent ocular defects. They ranged in age from three to 30 months.

Group 3 28 children with anisometropic amblyopia of a moderate degree. They ranged in age from five to 11 years.

Group 4 22 children, all of whom had a convergent microtropia which measured 10 or less on a simultaneous prism cover test. They ranged in age from three to 11 years.

All children, with the exception of the control group had a full ophthalmological examination. All had a routine orthoptic test. The Titmus, T.N.O. and Lang tests were performed on all children. A stereoscopic response was said to be positive if:

(a) any objective response was noted (i.e. if the examiner observed the movements of a child's eye from one test object to another, or

(b) any subjective response was noted (i.e. a verbal or kinetic response, e.g. "pinching" the fly's wings) which indicated that the child could appreciate the test object stereoscopically.

RESULTS

The results of testing the children in the four groups are shown in the table and graph below.

DISCUSSION

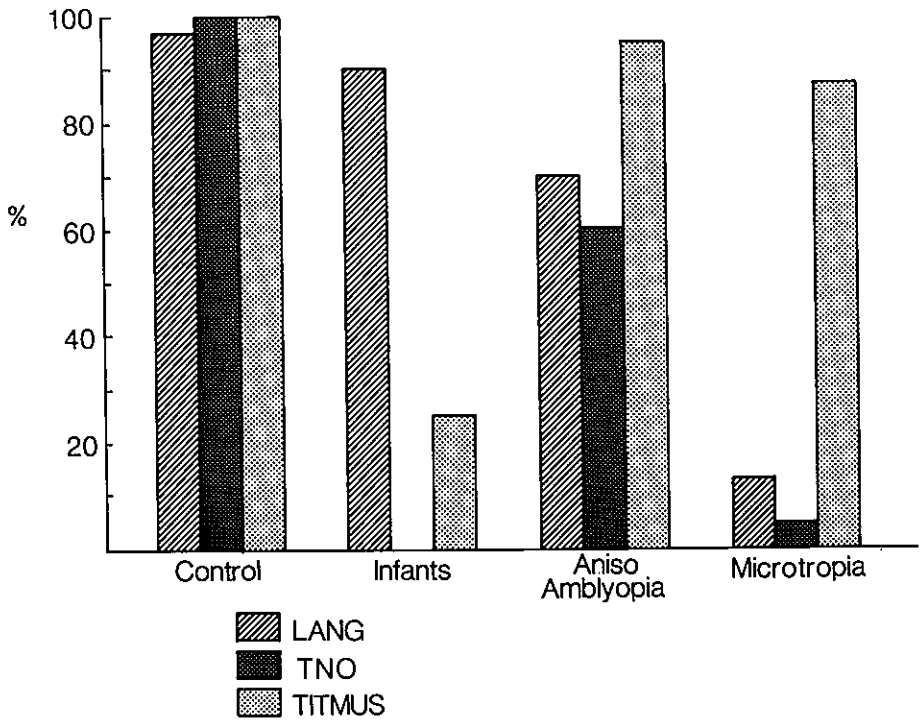
All children in group 1 performed well on the three tests, as expected because they had no ocular defects and were sufficiently mature to perform the tests. It should be noted that the results of the Lang test are similar to the other two tests.

TABLE 1

Percentage (%) of children who gave a positive stereoscopic response on the Lang, T.N.O. and Titmus tests.

	Lang	T.N.O.	Titmus
Group 1 (control) n = 22	97	100	100
Group 2 (infants under 3 years). n = 12	90	0	25
Group 3 (anisometropic amblyopia). n = 28	70	60	95
Group 4 (microtropia) n = 22	13	5	85

GRAPH 1. % of positive stereoscopic responses



Infants

Group 2 consisted of normal subjects under the age of 30 months.

Twenty-five percent (25%) of the infants gave a positive response to the Titmus, none responded positively to the T.N.O. while 90% responded positively to the Lang test (table, graph). Lang reported that the youngest child to perform the test was 8 months old. In this study, the youngest child was three months. It should be noted, however, that the child was the daughter of an orthoptist! The superior performance with the Lang test could be due to the design of the test which more easily elicits a stereoscopic response in this age group. The poorer performance of the infants as compared to the control group, especially with the Titmus and T.N.O. tests, can possibly be explained by the difference in ages between the two groups.

Anisometropic Amblyopia

In group 3 there was an overall pass rate of 75% with the three tests which indicates that none of them appear to be adequate as screening devices to detect the presence of anisometropic amblyopia. Within the group, however, a greater failure rate was evident with the T.N.O. and Lang tests than with the Titmus (table, graph), but there was no significant statistical difference between the results of the three tests. The results support Lang's assertion that subjects with moderate degrees of anisometropic amblyopia generally pass his test.

Microtropia

In this group, the greater failure rate with the Lang and T.N.O. tests as compared to the Titmus proved to be statistically significant. It is interesting to note that the higher failure rate

was evident with the two tests (Lang and T.N.O.) which are based on the random dot principle. The results support Lang's claim that subjects with microtropia generally fail his test, and also indicate that the Lang and T.N.O. tests are more reliable than the Titmus test for the screening of microtropia.

CONCLUSIONS

In summary, the results of this study support Lang's claims that subjects with microtropia usually fail to give a stereoscopic response to his test, while subjects with a moderate degree of anisometropic amblyopia generally pass.

Lang has said that his test is suitable for infants. It is an easy test to administer, no spectacles are needed and it is possible to objectively assess the child's reaction. The results of the study tend to support this view.

The Lang test was designed as a screening test, not as a measure of quantitative stereopsis. This study has found that it is a more reliable screening test for microtropia than the Titmus test. It is a comparable screening test of moderate degrees of anisometropic amblyopia, though with an overall pass rate of 75%, none of these stereoscopic tests appear to be reliable screening tests for this condition.

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COLOUR VISION TESTS AND THEIR INTERPRETATION

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Abstract

Patients with colour vision defects characteristically confuse reds and greens or blues and yellows. Exactly which pair is confused is of significant diagnostic importance and it forms the basis of the pseudoisochromatic colour vision tests and the diagnostic basis of the arrangement colour vision tests (i.e. the Farnsworth-Munsell tests).

This paper discusses the major types of colour vision tests. The application of the tests and interpretation of the results is outlined and illustrated with case studies.

Key words: *colour vision tests, pseudoisochromatic tests, Farnsworth-Munsell tests, Ishihara, Hardy Rand Rittler, Nagel anomaloscope, lantern tests.*

INTRODUCTION

Colour vision defects may be congenital or acquired. Usually congenital colour vision defects are bilateral, symmetric and non progressive. Acquired defects are unilateral or bilateral, frequently asymmetric and progressive. Hence when a congenital defect is suspected colour vision testing may be performed binocularly, whereas the eyes should be tested individually in cases of acquired colour vision defect.

All the colours in the visual spectrum can be joined up to form a colour circle. There are four unique points on the colour circle where a colour occurs alone without a trace of another colour. (For example at one point there is a pure yellow which has no trace of red or green). The colours at these points are red, yellow, blue and green. All other colours on the circle are combinations of two or more of these four unique colours.

Patients with colour vision abnormalities usually confuse mixtures of these pairs of unique colours, i.e. they confuse reds and greens or they confuse blues and yellows. Exactly which pair is confused is of significant diagnostic importance and this forms the basis of the structure of the pseudoisochromatic colour vision tests and the diagnostic basis of arrangement colour vision tests.

This paper discusses the major types of colour vision tests.

PSEUDOISOCHROMATIC TESTS

This group of tests includes the Ishihara, Guy's Children's Colour Vision Test, Matsubara Children's Colour Vision Test, the Standard Pseudoisochromatic Plates and the Hardy Rand Rittler Test (HRR).

Each test consists of a book containing a number of 'plates'. Each plate shows a series of coloured dots forming a figure embedded in a coloured background. The colour of the dots in the figures and those in the background are selected to confuse red-green colour defective

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patients while allowing normals to see the figures clearly. Those with congenital red-green colour vision defects cannot see any figure on all the plate hence the name; pseudo means falsely or seemingly, iso means one and chromatic means colour. To the colour defective patients the plates are seemingly one colour.

The main advantage of such tests is that they are very quick and simple to perform for both patients and examiner. Also the results are easily interpreted, however their application is limited.

All of the pseudoisochromatic tests are designed to detect *CONGENITAL RED-GREEN* colour vision defects. Patients with such colour vision anomalies show characteristic patterns of colour vision abnormality so the tests consist of colours which exploit these characteristic abnormalities.

None of the pseudoisochromatic tests (with the exception of the HRR) can detect blue-yellow defects. Pseudoisochromatic tests are usually not used (or designed) to detect acquired red-green defects.

Number of Plate	Normal Person	Person with Red-Green Deficiencies				Person with Total Colour Blindness and Weakness
1	12	12				12
2	8	3				×
3	6	5				×
4	29	70				×
5	57	35				×
6	5	2				×
7	3	5				×
8	15	17				×
9	74	21				×
10	2	×				×
11	6	×				×
12	97	×				×
13	45	×				×
14	5	×				×
15	7	×				×
16	16	×				×
17	73	×				×
18	×	5				×
19	×	2				×
20	×	45				×
21	×	73				×
		Protan		Deutan		
		Strong	Mild	Strong	Mild	
22	26	6	(2)6	2	2(6)	
23	42	2	(4)2	4	4(2)	
24	35	5	(3)5	3	3(5)	
25	96	6	(9)6	9	9(6)	

Figure 1: Ishihara test score sheet (reproduced from instruction booklet).

Ishihara colour vision test

As the Ishihara is a typical pseudoisochromatic test it will be discussed. The other test to be discussed is the HRR.

The Ishihara test consists of 36 plates. When doing the test the test plates must be well illuminated with daylight or a daylight globe (i.e. a Macbeth Easel light which transmits wavelengths of light that simulate daylight or a globe that gives a colour temperature of 6740° Kelvin).

Plate number 1 is the only plate in which the colour difference and contrast between the number and the background is so great that even the totally colour blind observer can see the number 12, hence this plate is used to screen for malingering patients. If a patient claims to see no figure on this plate then there is no point in continuing with the test.

Plates 2 to 9 are designed so that the red-green defective patient sees numbers but interprets them incorrectly. In plates 10 to 17 the red-green defective patients see no numbers at all. This is in contrast to plates 18 to 21 where the normal sees *NO* numbers but the red-green defective patients do see numbers.

Plates 22 to 25 are the 'diagnostic' plates. Only those patients who have failed (i.e. shown red-green deficiencies) on the first 21 plates should be shown the diagnostic plates. These four plates classify the red-green defective patient into protanomaly (red cone anomaly) and deuteranomaly (green cone anomaly). See Figure 1.

The remaining plates (25 to 38) are designed for the illiterate observer. They are asked to trace a line between the two 'x's.

The patients response to each plate is recorded. Errors are determined by comparing the patients response to the answers which are printed on the score sheet (see Figure 1). Where there are more than six errors between plates 2 and 21 (giving incorrect responses as shown on the score sheet) there is a congenital colour vision defect.[1] The

severity of the defect found on the Ishihara is measured in terms of a number of errors made.

The major shortcoming of the pseudoisochromatic tests is that patients with poor visual acuity may fail the test. In such a case the result may be misinterpreted as a red-green defect.

Another problem with the pseudoisochromatic tests is that many clinicians are unaware that patients with acquired colour vision abnormality are able to pass the test. Hence on the basis of the pseudoisochromatic tests some patients with acquired red-green colour vision defects are pronounced normal.

Hardy Rand Rittler (HRR) colour vision test

The HRR test is the only pseudoisochromatic test which screens for both red-green and blue-yellow defects. The test consists of six screening plates, 14 diagnostic plates and a control plate. As in the Ishihara test the figures on the control plate can be seen by colour blind subjects. All the plates in the test consist of coloured dots which form a symbol such as 'O' or 'X'.

If the patient passes the six screening plates then they have normal colour vision and no more testing is necessary. If errors are made on plates 1 and 2 the patient has a blue-yellow defect. The examiner then proceeds to the diagnostic plates. These plates classify the tritan (blue-yellow) defect as mild or severe. Alternatively if the patient makes errors on plates 3 to 6 the patient has a red-green defect. The examiner then proceeds to the diagnostic plates. These plates classify the severity of the red-green defect.

Like the Ishihara test the patients response is recorded on the score sheet and diagnosis of the type and severity of the defect is apparent.

The HRR test has particular advantages because it screens for blue-yellow defects as well as red-green defects and the symbols make it easy for both the illiterate observer and the child. The major disadvantage is that patients with poor visual acuity may fail the test and incorrectly be labelled colour blind.

ARRANGEMENT COLOUR VISION TESTS

This group of tests includes the Farnsworth-Munsell (FM) 100 Hue and FM Panel D-15. The tests consist of a series of colour samples called 'chips'. The patient is required to organise the chips into a specific order forming a hue circle. The tests are performed monocularly when the suspected defect is acquired and binocularly if the defect is congenital. Contrary to the manual there should be no time limit for either test.[2] FM tests are performed under a daylight light.

Arrangement tests are designed to detect any type of abnormality in colour vision perception from minor errors made by the normal observer to total achromatopsia (total colour blindness), and test for both congenital and acquired defects, red-green and blue-yellow defects.

FM Panel D-15 colour vision test

This test is designed to select patients with moderate to severe chromatic discrimination loss. The test consists of 15 loose chips and one chip fixed in the box (i.e. the reference chip). The colour (or hue) on each chip has been chosen so that adjacent chips have approximately equal hue differences.

The patient is instructed to arrange the chips in order according to colour in the box starting next to the reference chip.

Once completed, the box is shut and inverted then re-opened. A number is then seen underneath each chip. The order in which the patient has arranged the chips is recorded and plotted on the score sheet (see Figure 2). Starting from the reference cap (point 'P' on the circular diagram) the points are connected according to the order given by the patient. Figure 3a shows the result for a normal subject.

The hue differences between adjacent chips are equal but of large degree thus errors can be made across the hue circle (for example green could be placed next to purple). Thus colour deficient observers make characteristic errors across the colour circle when performing this test. A typical pattern is seen in Figure 3b for a deuteranomoly (green deficiency), Figure 3d for protanomaly (red deficiency) and Figure 3c for tritanomaly (blue deficiency) with lines being drawn across the circle.

Subjects with normal colour vision sometimes make one or two minor errors (e.g. reversing

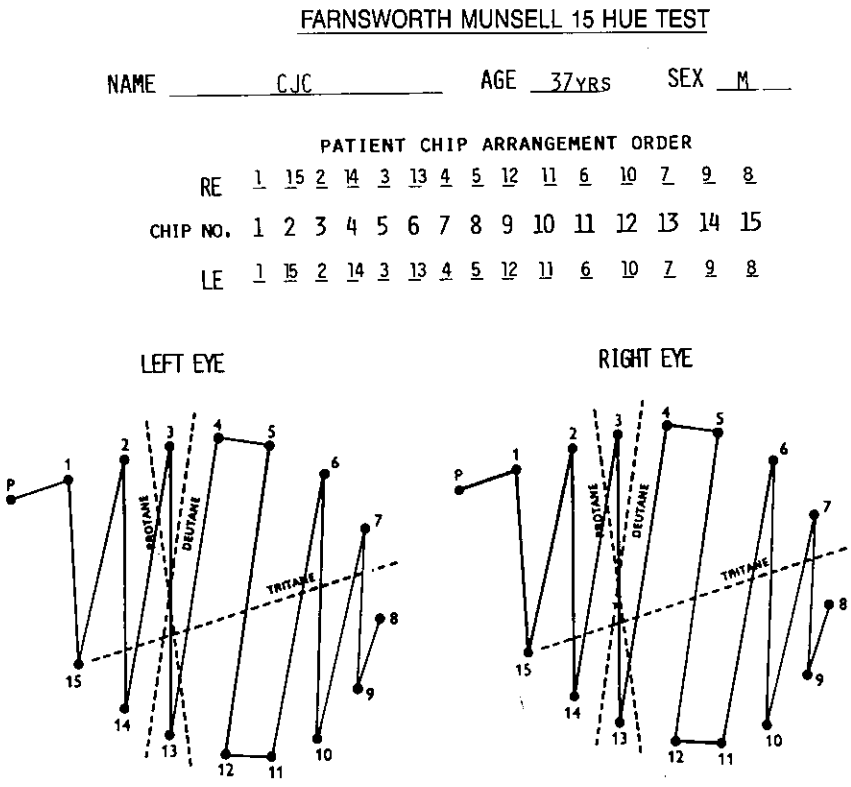

Figure 2: Score sheet for a FM Panel D-15 colour vision test.

chips 2 and 3). However, in our experience any more than two minor errors should not be considered normal. The patient may have a mild colour vision deficit which is not being detected on the FM 15-D hence they should be tested on the FM 100 Hue. Figure 4 is an example of a subject who 'passed' the 15-D test and showed marked colour vision abnormality on the 100 Hue. We have had six such subjects over a period of eight months in our department.

The FM 15-D test is once again very quick and easy to perform, score and interpret. However, the clinician should be aware that some colour defective patients can 'slip through' this test.

FM 100 Hue colour vision test

Of the tests mentioned so far, the FM 100 Hue is the test that is most likely to detect colour vision abnormalities, even in their mildest forms. The test consists of 85 chips of perceptually equal steps of hue. When put in correct order, the 85 chips form a hue circle.

The subject is asked to arrange the chips in the appropriate colour order between the two chips fixed at either end of each of the box. The colour differences between adjacent chips is so small that correct arrangement of the chips requires both normal colour vision and a good ability to discriminate between shades of the same colour. As the chips are divided into four boxes of 21 or 22 chips, any errors that occur are between adjacent chips, *NOT* across the hue circle (as seen in the FM D-15 test).

In a similar manner to that described for the FM 15-D test the subjects chip order is recorded, however, scoring and interpreting the FM 100 Hue test is more complicated.[3] The score for each individual chip is calculated by summing the absolute difference between adjacent chips. For example if the patient chip order was 9, 6, 3, 8,

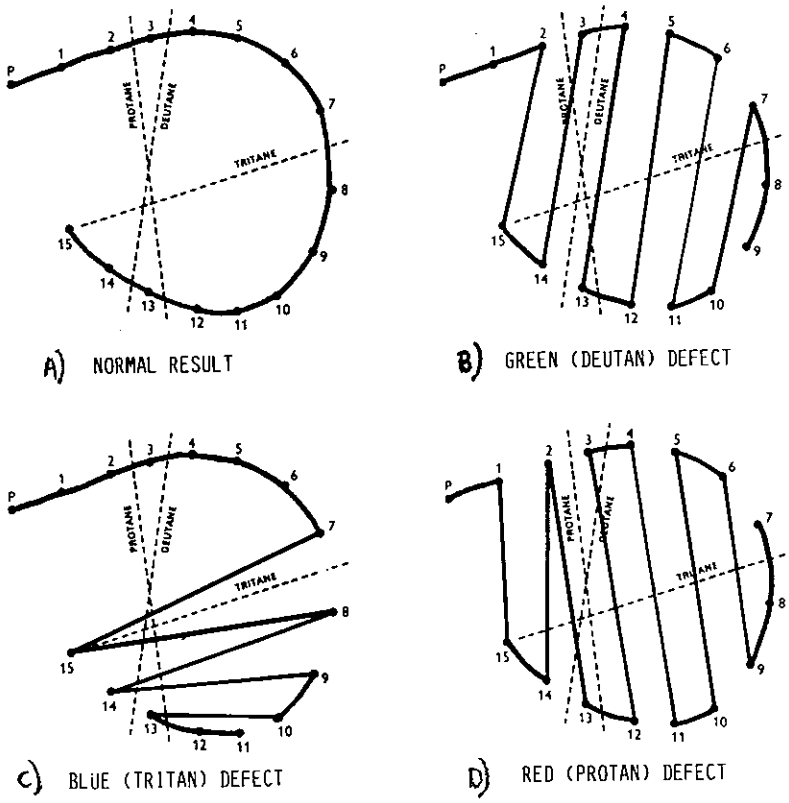

Figure 3: FM Panel D-15 test results. 3a Normal, 3b Deutan, 3c Tritan and 3d Protan.

4, etc., the score for chip '3' would be as follows:

The absolute difference between the preceding chip ('6') and chip '3' is 3. The absolute difference between chip '3' and the following chip (i.e. chip '8') is 5. The sum of the absolute differences is $3+5=8$, hence the score for chip '3' is 8.

This score is then plotted on the hue circle (see Figure 5).

With this scoring method, the minimum score for each chip is 2. For example if the patient order was 5, 6, 7, 8, 9, ... the absolute difference between each adjacent chip is 1. The sum of the absolute difference is $1+1=2$, hence the minimum score for each individual chip is 2.

After the score for each individual chip has been calculated this score is plotted on a circular hue graph. The inner circle of the graph gives the chip number and the vertical axis at 12 o'clock gives the score (see Figure 5).

The scores for each individual chip are then added together giving a total score. As there are 85 chips (each with a minimum individual score of 2) the 'perfect' score is 170 (i.e. 85×2). Of the more than 1000 FM 100 hue tests scored in our department, not one has had a perfect score of 170. This is so because the hue differences between adjacent chips is so small that normal observers (with 6/5, N5 vision) cannot tell the difference between all adjacent chips. In our department a score of 240 is considered normal (see Figure 6a).

An abnormal score (more than 240) tells the clinician that there is a colour vision abnormality

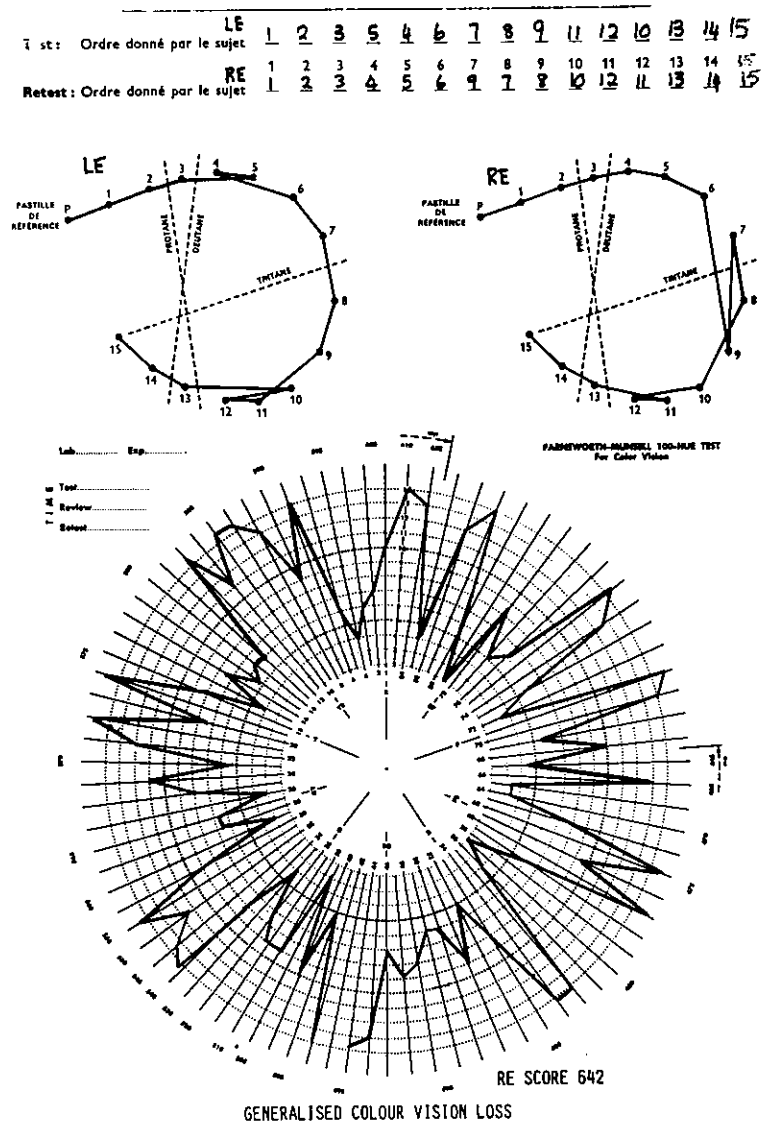

Figure 4: FM Panel D-15 and FM 100 Hue test results from the one patient. The patient passed the D-15 test and showed a severe colour vision defect on the 100 Hue test.

but; the score alone does not tell the clinician anything about the nature of the defect hence the reason for graphing the individual scores for each chip on the circular graph. Patients with congenital colour vision defects always show concentrations of errors in two well defined areas called poles. The poles occur in characteristic areas which depend on the type of deviation present.

The most common colour vision defect is the congenital defect, anomalous trichromatism. Patients with this condition have a normal population of cones all of which contain one of the three cone pigments (i.e. red, green or blue). However, there is a slight abnormality in one cone pigment. As a result the cone pigments maximally absorb slightly shorter or slightly longer wavelength light than normal cones.[3] This

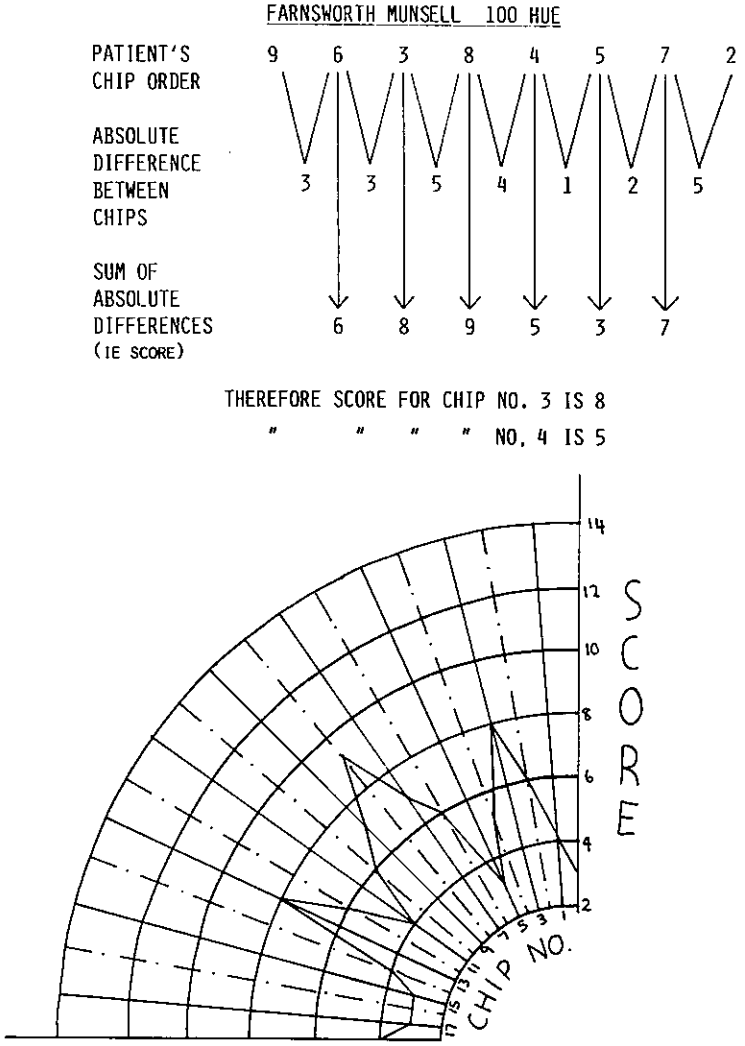

Figure 5: Scoring the FM 100 Hue colour vision test.

defect is divided into three subgroups

(1) deuteranomaly (red-green defect with abnormal green cone pigment).
(2) protanomaly (red-green deficit with abnormal red cone pigment)
(3) tritanomaly (blue-yellow deficit with abnormal blue cone pigment).

(the prefix deut means green, prot means red and trit means blue. The suffix -anomaly means abnormality).

Under normal colour vision testing conditions of bright light the red-green deficiency patients have no trouble differentiating pure reds and pure greens. Rather, they have problems with colours that fall between red and green on the colour circle, i.e. blues and yellows. This is clearly demonstrated on a FM 100 hue (see Figure 6b and 6c).

Deuteranomalous subjects score almost perfectly on the red and green areas of the colour circle and have most problems with colours lying in the areas between red and green, namely

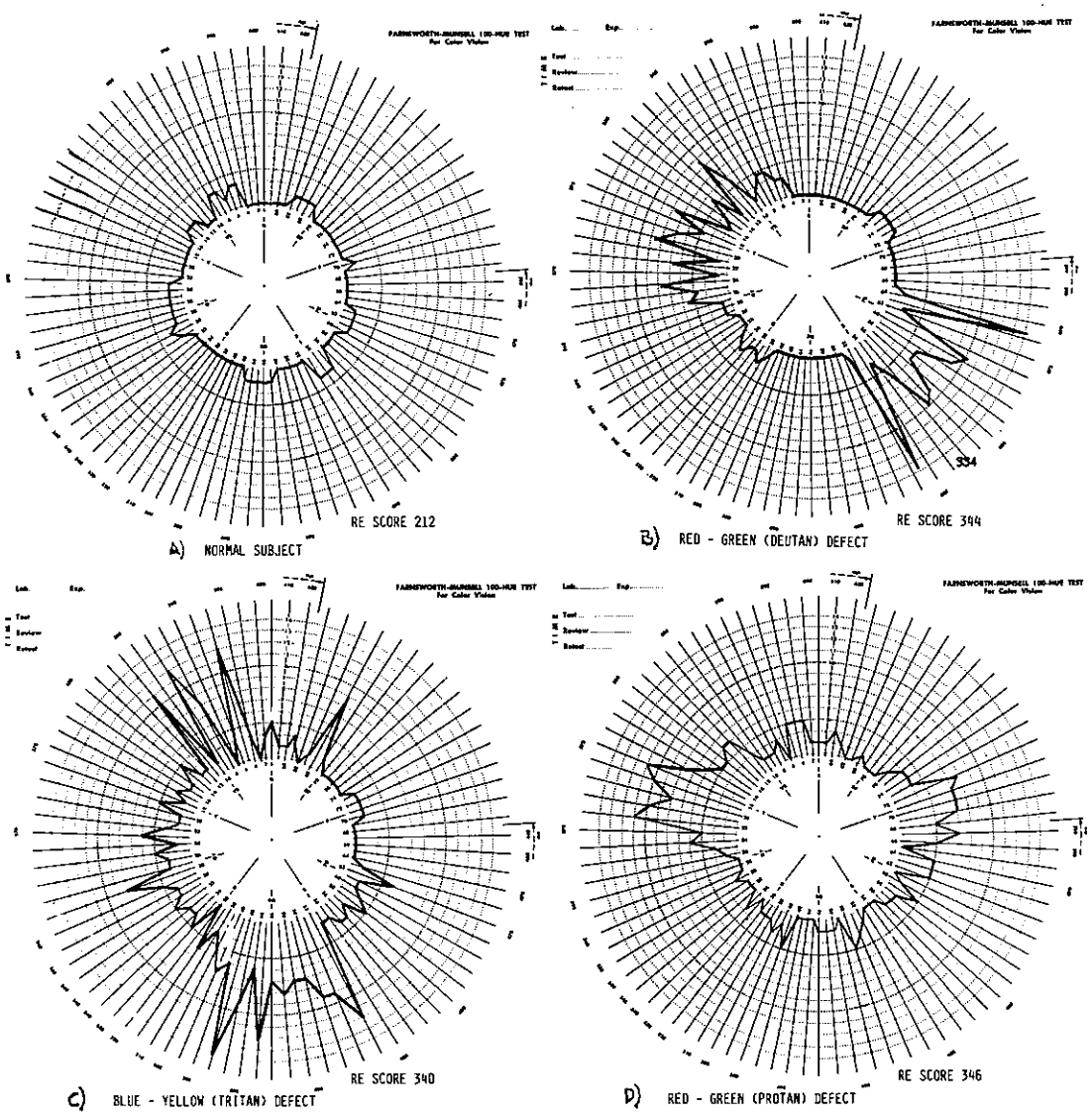

Figure 6: Typical results obtained on the 100 Hue test. 6a Normal, 6b Deuteranomalous, 6c Tritanomalous and 6d Protanomalous.

purple and blue and fewer problems with orange and yellow. Protanmalous subjects also score perfectly on the red and green axes. They have most problems with purples and some problems with yellows hence their typical response is more horizontal in appearance than that of the deuteranope.

The typical result on the FM 100 Hue test for a tritanopic subject (blue-yellow defective) is different. They score perfectly on the yellow and blue axes of the colour circle. Errors occur in the areas that lie between blue and yellow, namely green and orangy red (see Figure 6d).

Generalized loss of colour discrimination ability shows errors right around the circular graph (see Figure 4).

Another type of colour vision abnormality is dichromatic colour vision. This condition is

thought to be due to either an absence of one cone pigment (hence the patient must colour match using only two of the three cone pigments) or, the abnormality may be due to a post receptoral defect.[4,5] Dichromatic abnormalities are deuteranopia, green cone anomaly (the suffix -anopia meaning absence of), protanopia, red cone anomaly and tritanopia, blue cone anomaly. Dichromatic observers show an abnormality only in one particular area on the FM 100 hue graph if the abnormality is the result of an absence of one pigment.

COLOUR MATCHING TESTS

To date all the tests mentioned have the *CONFUSION* tests, that is they are based on the fact that patients with colour vision defects characteristically confuse certain colours. The next group of tests to be discussed are sensitivity tests. They test the patients ability to match various defects. The tests include the anomaloscope and the lantern tests.

Nagel Anomaloscope

When seated looking into the eyepiece of the anomaloscope the patient views a bipartite circular field. One half of the field is covered with a yellow hue of variable luminance. The other half consists of a variable red-green mixture of fixed luminance. The patient is asked to match the yellow seen in the bottom half of the field using a mixture of reds and greens in the top half of the field.

Deuteranomalous patients (green abnormality) would add a lot more green to complete the colour match in an anomaloscope. Protanomalous patients (red abnormality) would add more red to colour match.

Tritan defects (blue abnormalities) cannot be detected using the Nagel anomaloscope.

The Lantern tests

These tests are used for screening for colour vision defects without diagnosing the type or degree of colour vision defect.

The patient is presented with single (Edridge Green lantern) or a paired (Sloan) coloured signal and is asked to name the colours which are presented. Colours are presented at different luminance levels and different visual angles. Patients with anomalous trichromatic colour vision have most trouble detecting pure colours at low luminance levels.

The tests are used for screening prospective employees in areas such as the navy, airforce and train drivers; that is occupations where recognition of signals in poor light conditions is vital. Altering the luminance level simulates conditions such as rain or mist.

DISCUSSION

Features in the clinical examination which should alert the clinician to the possibility of a colour vision abnormality include:

(1) History: the patient or parent may volunteer a history of poor colour vision.
(2) Bilaterally reduced visual acuity, especially for near, in the presence of straight eyes. (Bilaterally reduced vision may be indicative of cone dysfunction especially if there is an associated loss of colour vision).
(3) Nystagmus: colour vision should be assessed in all cases of congenital nystagmus. Once again the nystagmus may be indicative of cone dysfunction.
(4) Recurrent amblyopia, especially if near vision is reduced; progressive cone dysfunction may be the underlying abnormality in some cases of apparent amblyopia. Loss of colour vision may alert the clinician to the fact that the problem may be more than just amblyopia.

Colour vision defects, even the non progressive ones such as anomalous trichromatic colour vision (a condition in which the patient has otherwise normal vision) are important to detect as the patient must be aware that certain career opportunities will not be available to them.

CONCLUSIONS

The colour vision tests which are most commonly used (such as the Ishihara) are those which are quick and easy to perform, score and interpret. Although these tests are the most practical to use, clinic clinicians must be aware of their limitations. If results obtained on the pseudo-isochromatic tests or the FM D-15 test are not

perfectly normal, yet do not fit into any pattern of abnormality, a FM 100 hue test should be performed. Conversely, a patient complaining of diminished colour perception should not be considered to have normal colour vision when they have only passed the Ishihara test for congenital red-green colour blindness.

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VISUAL STANDARDS OF THE PARTICIPANTS IN THE SHAKLEE* JUNIOR SPORTS DEVELOPMENT PROGRAMME

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Abstract

47 junior sports athletes from the sports areas of track and field, swimming, gymnastics and tennis were assessed to determine their ocular responses in a variety of tests including visual acuity, stereoacuity, convergence and deviation size. Results indicate that overall these athletes achieved a high standard for most test procedures, with the tennis players achieving a significantly higher standard in stereoacuity tests. Junior athletes in the swimming groups demonstrated a reduced visual function.

Key words: *junior athletes, track and field, gymnastics, tennis, swimming, visual acuity, strabismus, heterophoria, convergence, accomodation, stereoacuity, ocular movements.*

This study was part of a programme to monitor the health of junior athletes and to study the effects of an intensive training programme undertaken by them.

The junior athletes were selected by the appropriate sporting associations for each of four athletic disciplines; namely track and field, gymnastics, swimming and tennis. The association were to name one male and one female from each of the age groups between 10 and 15 years. Thus the total expected in the programme was 48 athletes.

There were 47 athletes seen, of which 15 were from track and field sports area, nine were gymnasts, 11 were swimmers and 12 were tennis players. The age range of the athletes was between 10 and 15 years with an average of 13.3 years.

A series of general physical tests was carried out by the staff at Cumberland College of Health Sciences. Testing of the visual function was conducted by the staff of the School of Orthoptics.

METHOD OF VISUAL ASSESSMENT

Forty-seven athletes were screened. An ocular history was recorded which included details of the athlete's age, the sports area in which the athlete excelled, the presence of visual symptoms and any previous ocular treatment.

Visual acuity (Tables 1 and 2)

This was tested uniocularly with Snellen's test to the maximum level each athlete was able to read. The distance vision was tested at 6 m with a maximum level possible of 6/3. The near vision was tested at approximately 1/3 m using the reduced Snellen's test for which the maximum level possible was 6/5.

* Shaklee is an American multi-national company manufacturing and distributing natural cosmetics and multi vitamin supplements.

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TABLE 1
Visual Acuity Results

	Athletes		Brown
	Distance	Near*	
Vision 6/6 or better, both eyes	91.5% (43)	91.4% (43)	80%
Vision 6/6 or better one eye, 6/9 other	4.25% (2)	4.6% (2)	5.6%
Vision 6/9, both eyes	0	2.0% (1)	8.1%
Vision one eye less than 6/9	4.25% (2)	2.0% (1)	6.3%

* Tested with reduced Snellen's chart.

For athletes who wore glasses, vision was tested both with glasses and without glasses. For any athlete whose vision was reduced in either eye, the vision was retested through a pinhole. The maximum visual acuity obtainable is recorded and is used throughout the study as the visual acuity level.

Cover test and measurements (Tables 3 and 4)
Both tests were performed with the patient reading 6/6 print at both 6 m and approximately 1/3 m.

The measurement was performed by the prism and cover test method recording the prism strength below that which caused a reverse movement.

Ocular movements
These were tested in the nine positions of gaze. A cover test was performed in each position to demonstrate any slight variations in the deviation. This procedure reveals abnormalities which often have no significance in the primary position but may be of some significance on direct elevation and depression. The elevated position was particularly noted for potential involvement of the tennis players.

Convergence Near Point and Accommodation (Table 5)
These were both tested with the RAF rule and in cases when convergence near point was less than 6 cm convergence this was retested using an object. The distance, from the eyes, at which one eye failed to converge was recorded.

Accommodation was measured using N5 print moving the print away from the athlete. Both binocular and monocular tests were performed.

Stereopsis
This was measured in near position using the TNO stereotest. The level recorded for each athlete was the maximum level at which each athlete could see both plates correctly.

TABLE 2
Visual Acuity at 6 m

right eye \ left eye	<6/9	6/9	6/6	6/5	6/4	6/3
<6/9		1	1			
6/9			1			
6/6		1				
6/5				20	6	
6/4				2	14	
6/3						1

RESULTS

The number of studies conducted on general population groups is severely limited, therefore the information gained from this study could not be directly compared to a study of a population group of similar age, however, results are

TABLE 3
Cover Test Results

	Athletes		Brown
	%	No.	%
Athletes with strabismus	4.25%	(2)	3.5%
Athletes with orthophoria	21.25%	(10)	40.7%
Athletes with heterophoria	74.50%	(35)	55.8%

TABLE 4
Heterophoria Distribution (disclosed by cover test)

	Near	Dist.	Near and Dist.	Total		Brown
				No.	%	
Esophoria	5	0	1	6	17%	15.89%
Exophoria	26	0	3	29	83%	83.84%
Hyperphoria	0	0	0	0	0	0.27%
Total	31	0	4	35	100%	100%

Heterophoria Distribution (disclosed by cover test)

compared to four studies: one by Brown *et al.* (1977)[1] on children considerably younger, four to seven years; one by Frisby *et al.* (1981)[2] whose subjects had a mean age of about 20 years; one by Mazow (1983)[3] on subjects whose ages ranged between 6 and 74 years; and one by Turnbull (1978)[4] whose ages ranged between 4 and 71 years.

Symptoms

Seven athletes had headaches or discomfort for near, five of these had an excellent ocular standard with full convergence and normal accommodation. One had deficient convergence (9 cms) and one had microtropia.

It is interesting to note that gymnasts were the only athletes who were symptom free. It is also interesting to note that the athletes from the swimming discipline were the only athletes who had been prescribed optical correction, one being myopic.

Visual Acuity

The recorded maximum levels of visual acuity (Table 2) demonstrate that the majority of the athletes (91.5%) had vision at 6 m of 6/6 or better in both eyes. When comparing the results to a study carried out by Brown *et al.*[1] on 5,436 kindergarten children it can be seen (Table 1) that despite the differences between the ages of the subjects and the testing procedures in the studies, the overall distribution of vision responses of the athletes is similar to the distribution of vision responses of the kindergarten children.

The athletes had a greater proportion (91%) with vision 6/6 or better in both eyes, which possibly may have been related to age and their greater ease of performing the test.

Analysis of the range of visual acuity levels within the different sports groups showed that the swimming group had a level which ranged between 6/4 and 6/24 for distance and from 6/6 to 6/60 for near, whilst the remaining groups ranged between 6/3 and 6/9 for distance and from 6/6 to 6/9 for near. Bearing in mind the small number (11), the results for the swimming group suggest that visual levels are not as important for this group as for other groups.

Deviation type

The distribution of the type of deviation as determined by the cover test is similar to the distribution found by Brown *et al.*[1] (Table 3) with the smallest percentage of deviations being strabismus. One of the athletes who had strabismus was from the swimming group and the other from the track and field group. The athletes had a significantly higher proportion of members with an heterophoria than the kindergarten children ($P > 0.99\%$ using chi square test). Within the heterophoria category the distribution into esophoria, exophoria and hyperphoria shows no significant difference between the two studies (Table 4).

Deviation measurement

When the squints were excluded the average deviation size measured -2.97 prism dioptres for near and for distance was found to be -0.5 prism dioptres which relates well to the high incidence of exophoric deviations in the athletes as a whole.

Convergence

Results (Table 5) showed that most athletes had a level of convergence between 0 and 5 cm which

TABLE 5
Convergence Near Point—Result

	Athletes		Brown
	%	No.	%
Near point 0-5 cms	68	32	86.4%
Near point 6-10 cms	27.75	13	12%
Near point 11 cms +	4.25	2	1.6%
	100%	47	100%

Brown *et al.* classified as normal. Whilst the majority of athletes do fall within this range, the porportion of athletes in this category is significantly lower than that disclosed in the study of Brown *et al.* ($P<99\%$) and there are comparatively more athletes found in the reduced range of 6-10 cms ($P>99\%$). It is possible that the shift of distribution may be age related considering that the age of the majority of the subjects in the study by Brown *et al.* was five. Only one of the athletes in the group with reduced convergence had symptoms associated with close work.

Of the different sports groups, the tennis players had a higher proportion of members (83%) whose convergence was in the 'normal' range. However, because of the small sample size, the evidence is statistically inconclusive.

Accommodation

For each athlete, the level of accommodation for each eye was measured and compared to the athlete's expected level for age: the difference between the two levels for the left eye (L) was plotted against the difference between the two levels for the right eye (R) (Figure 1). The majority of the athletes showed the same standard for each eye ($L=R$), 25 above the normal level of accommmodation for the individual's age, eight with normal accommodation and five below normal. The other nine had different levels for each eye. The correlation between L and R is highly significant ($P>99.9\%$) and the least square linear regression equation was found to be $R=0.99\ (\pm0.10)\ *\ L+0.06\ (\pm0.22)$.

Tennis players and gymnasts showed their accommodation ability to be between normal and better than their age level whilst athletes for the track and field and swimmers were found across the full range. When the tennis players and gymnasts were grouped together and compared to the combined group of swimmers and track and field athletes, the responses of the tennis/gymnast group were found to be significantly better ($P>98\%$ using a chi square test) than the swimming/track and field group.

Stereoacuity (Table 6)

The responses for the group of athletes in this study were that 57.4% gained better than 60 seconds of arc with 46.8% gaining 30 seconds and 10.6% gaining 15 seconds of arc. The mean score for the group as a whole is 44.3 (±25.7) seconds of arc. The means for the individual groups were found to be: tennis 31 (±9.6) seconds, gymnasts 47 (±14.8), track and field 46 (±25.6) and swimmers 55.5 (±37.4) seconds of arc. Further analysis of responses in the individual sports groups shows that the gymnasts

TABLE 6
Stereopsis results—T.N.O.

	Seconds of Arc							Total
	15	30	60	120	240	480	nil	
Track and field	1	7	5	1			1	15
Gymnastics		4	5					9
Swimming	3	1	4	2			1	11
Tennnis	1	10	1					12
Total	5	22	15	3			2	47
Percent	10.6	46.8	31.9	6.4			4.3	100%

/// mean per Mazow
\\\ mean for athletes

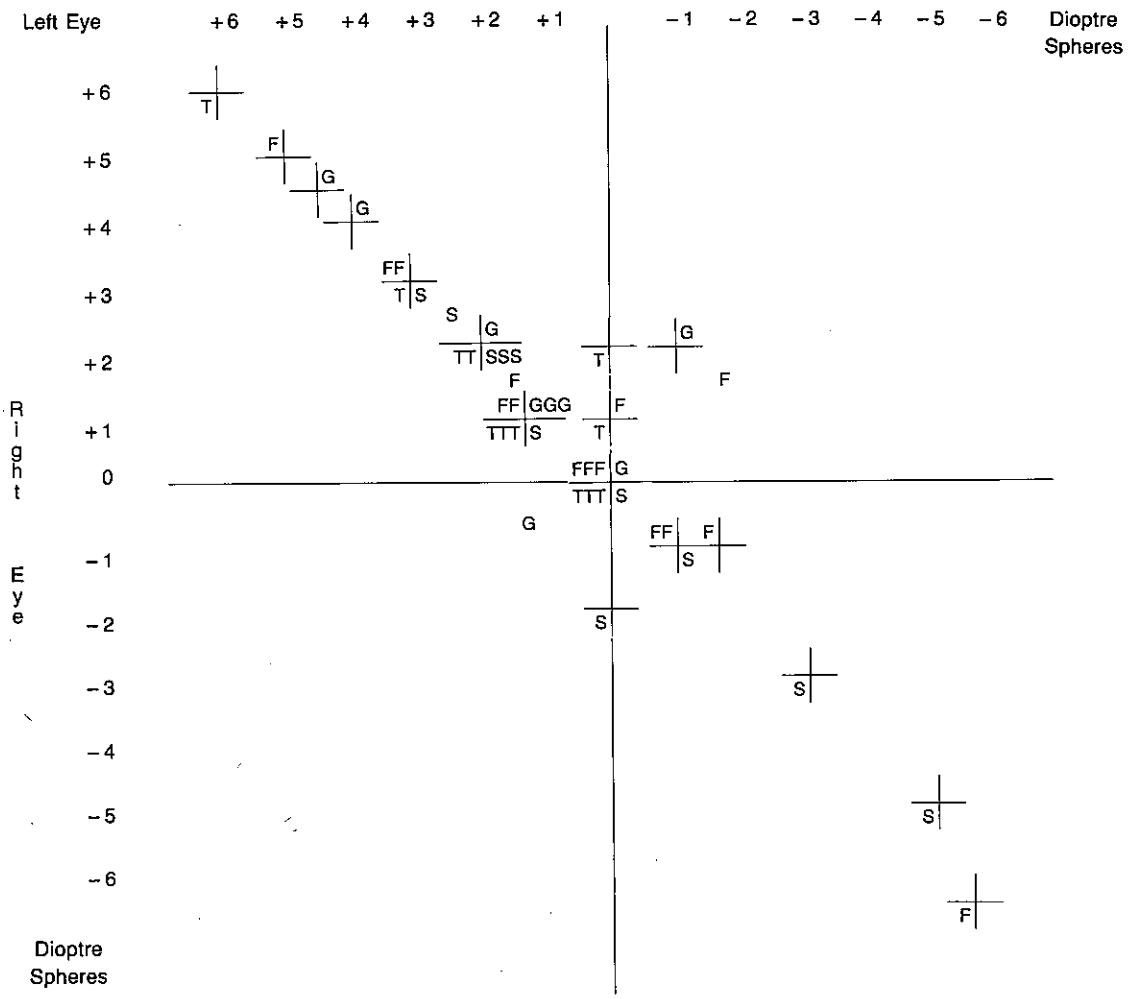

Figure 1: Accommodation responses.

and tennis players all appreciated stereopsis to a level of 60 seconds or better and that the responses of 90% of the tennis players were at a level of 30 seconds of arc or less. A chi-squared test of the response of the tennis players against the response of other athletes showed that the tennis players tested had a significantly higher level of stereoacuity (P > 99%).

Frisby *et al.*[2] in a comparative study of stereotests assessed 68 university students whose mean age was about 20 years. The mean of their initial response to the TNO test was 82 seconds of arc. This was almost double the value for the present study (44.3 seconds of arc) and the difference was found to be highly significant using a Student's t-test (P > 99.9%). Unfortunately, Frisby *et al.* did not tabulate their results, however, the distribution of their responses can be deduced from their graph and shows that there is a significant difference in the TNO results using chi-square test (P > 95%) between Frisby's group and the athletes. The responses of the athletes also showed much less variance than the responses of Frisby's subjects.

TABLE 7
Ocular Movement—Results

Athlete Group	Full Movements		Abnormal Movements	
	No.	%	No.	%
Track and field	6	40%	9	60%
Gymnastics	4	44%	5	56%
Swimming	7	63%	4	36.4%
Tennis	9	75%	3	25%
	26	56% (30.4%) Turnbull	21	44% (69.6%) Turnbull

Using the F-test, the difference was found to be highly significant ($P > 99.9\%$).

In a study to assess three stereoacuity tests Mazow[3] performed the TNO test on 50 subjects with ages in the range of six to 74 years, whose visual acuity was better than 6/9 and who had no squint. Mazow found the mean response to be 193.56 seconds of arc with a standard deviation of 17.98 seconds. This is a much reduced stereoacuity standard when compared to the response of the athletes in the study ($P > 99\%$) using the Student's t-test.

These results suggest that the athletes in this study and, in particular, tennis players have superior stereopsis.

Ocular movements (Table 7)
Forty-four per cent of the athletes demonstrated slight abnormalities of ocular movements with the majority of these being bilateral inferior oblique overaction. This is a similar finding to that of Turnbull,[4] and in most instances was only evident in extreme positions of gaze.

Fifty-six per cent of the athletes had full ocular movements. Comparing these responses to those found by Turnbull who, using the same testing procedure, found normal ocular movements in 30.4% of her group, it can be concluded that the results for the athletes is significantly better ($P > 98\%$ for chi-square test).

The tennis players had the largest proportion (75%) of athletes with normal ocular movements, which again suggests that visual function is more important to the performance of tennis players than to the performance of other tested athletes. (Not statistically significant due to small sample.)

CONCLUSION

Overall, the athletes in this study have better visual function than other population groups to which they have been compared. As discussed above, age differences between the groups may be a factor contributing to the observed visual standards. There is insufficient evidence on which to propose causative factors. Perhaps the differences are related to a difference in the athletes attitudes; their desire to achieve in their sporting endeavour may encourage a parallel approach in all activities. Alternatively one could speculate on whether the sporting activity promotes better visual performance or whether the visual performance enables premium sports performance.

It has been suggested that many people who are myopic and are talented athletically will preferentially develop their swimming skills because vision is less important in that sport. Consideration of athletes in the swimming group with accommodation better than age expectations, showed that all such people had no current difficulty with distance vision, their level being 6/4-6/5 in each eye. Only one of the swimmers was myopic. However, there were no myopic athletes in any other sports groups. It is also interesting that the athletes with the most reduced vision were swimmers and that one of the two athletes with a squint was a swimmer (the other athlete with strabismus was in the track and field group).

Conversely, tennis players had significantly better stereoacuity responses than other athletes and, together with gymnasts, had above average accommodations.

The results of this study, although representing only a modest number of athletes, suggest that the natural selection operating in sporting activities could be influenced by visual standards. Further work both on large groups of athletes and on the general population to establish average age-related visual standards should provide greater insight into this aspect and may

prove of benefit in the training and selection of athletes.

ACKNOWLEDGEMENT

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AWARENESS OF THE EYE HEALTH CARE TEAM BY OTHER HEALTH PROFESSIONALS

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Abstract

The orthoptist, ophthalmologist, optician and optometrist can only function at an optimum level if other health professionals are aware of their duties and capabilities. The need for interdisciplinary communication is ever increasing as technology expands and the population grows.

The aim of this paper is to explore the awareness that health professionals have of the eye health care team. The results indicate that this awareness can be improved and that steps should be taken to increase interdisciplinary skills so that the team approach can be maximised.

Key words: *orthoptist, ophthalmologist, optician, optometrist, interdisciplinary, team approach.*

INTRODUCTION

There has been much rhetoric about the improved patient care that arises from the performance of individual health professionals acting together as an interdisciplinary health care team. At the basis of this team approach there must be an awareness and understanding of the roles of each member.

This development in health professionals of an awareness of the role of their colleagues, can be attained in two ways. Firstly, as a result of their training as a student health professional, and secondly, as a result of clinical experience in the working situation.

Lincoln Institute of Health Sciences is a College of Advanced Education which provides training for a number of allied health professions. This setting would seem ideal for the education and encouragement of the team approach. It should, therefore, be of interest to evaluate the awareness of those academics who provide this education, since it is they who are responsible for developing the interdisciplinary approach to human services in the student.

For this reason it was decided to assess the awareness of the eye health care team by academic staff at Lincoln Institute. This group being representative of the two main areas where the team approach should be paramount—they are both health professionals and educators.

METHOD

A self administered questionnaire was sent through the interdepartmental mail to 42 academics. This sample population represented 20% of the total academic staff and was randomly selected from the four largest training schools, these being Nursing, Communication Disorders, Occupational Therapy and Physiotherapy. A total of 25 persons responded giving a return rate of 59.5% (Table 1).

Of the respondents 76% were female and 24% were male. The percentages of those in each age group are found in Table 2.

Reprints from: School of Orthoptics, Lincoln Institute of Health Sciences, 625 Swanston Street, Carlton, Victoria, 3053.

TABLE 1
The Sample Population

	No. sent	No. returned	% of total sample from each school
Nursing	8	4	16
Comm. disorders	8	6	24
Occ. therapy	10	5	20
Physio-therapy	16	10	40
	42	25	100

RESULTS

The first question asked the subjects whether they had heard of these members of the eye health care team—orthoptist, ophthalmologist, optician and optometrist. Eighty-four per cent had heard of orthoptist, 96% of ophthalmologists, and all the respondents (100%) had heard of optician and optometrist. However, of these only 76.1% could define the duties of the orthoptist, 91.6% for ophthalmologist and 88% for optician and optometrist.

These findings support those of Levi et al[1] who in a survey of 643 members of the public found that the most frequently correct response was for the definition of ophthalmologist (80.4%), with optometrist (72.7%) and optician (66.2%). Unfortunately they did not include the orthoptist in their questionnaire.

The subjects were then asked where they might find each of the professionals working (Table 3).

The next question asked if they had ever visited these professionals, and if so, for what reasons (Table 4).

The subjects were asked if a referral was necessary to visit these professionals (Table 5).

The subjects were then asked to state what training was necessary for each profession; 56% gave a correct response for orthoptics, 68% for ophthalmology and 20% for optometry, but no-one knew about opticianary.

There was a question about who could provide the following treatments—glasses, eye exercises, eye drops and eye surgery (Table 6).

Finally, the subjects were asked to indicate which one professional they would visit if they had the symptoms or complaints listed (Table 7).

TABLE 2
Percentage per Age Group

20-30 years	12
30-40 years	52
40-50 years	24
>50 years	12

TABLE 3
Frequency of Places of Employment

	Orthoptist	Ophthalmologist	Optician	Optometrist
Hospital	16	22	4	7
Private practice	10	22	23	24
Other	6	3	—	—
Not known	8	1	2	1

TABLE 4
No. of Visits and Reasons Given

	Orthoptist	Ophthalmologist	Optician	Optometrist
Vision	2	9	2	7
Headaches	—	1	—	—
Squint	—	1	—	—
Spots before eyes	—	1	—	—
Glasses	—	—	5	8
Total	2	12	7	15

TABLE 5
Nos Indicating Knowledge of Referral System

	Orthoptist	Ophthalmologist	Optician	Optometrist
Referral necessary	5	17	1	6
Referral not necessary	6	5	19	13
Not known	15	3	5	6

TABLE 6
Responses Regarding Treatment

	Orthoptist	Ophthalmologist	Optician	Optometrist
Glasses	2	11	21	22
Eye exercises	20	15	9	14
Eye drops	3	23	4	7
Eye surgery	—	24	1	1
Not known	5	1	2	1

TABLE 7
Nos Who Would Visit the Professionals for these Symptoms/Complaints

	Orthoptist	Ophthalmologist	Optician	Optometrist	Not Known
Sore eye(s)	2	17	3	2	1
Painful eye(s)	1	20	1	2	1
Itchy eye(s)	2	17	2	2	2
Spots in front of eye(s)	1	18	3	2	1
Crossed eye(s)	4	16	3	1	1
Red eye(s)	1	20	2	1	1
Sudden loss of vision	—	23	1	—	1
Blurred vision	1	17	2	4	1
Double vision	2	17	2	3	1
Headaches	—	17	3	5	—
Old glasses	1	2	6	16	—
Glasses broken	—	—	11	14	—
Glasses lost	—	—	8	16	1

At the conclusion of the questionnaire general comments were requested; 32% responded expressing concern about their lack of knowledge in the area surveyed and of determination to improve their awareness of the eye health care team.

DISCUSSION

The results indicate that despite a high percentage of health professionals 'having heard' of the eye professionals, their level of awareness of the eye health care team needs to be improved. It seems that of the four professionals, the orthoptist is the one that the respondents were less aware of. This supports the findings of Bartley[2] and Barnard.[3]

By increasing health professionals awareness, the interdisciplinary approach to patient care should become more effective and provide maximum services to the patient. Through education in this area the image of the orthoptist will be improved and the notion of the team approach will become a functional one.

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Australian Orthoptic Journal 1985; 22: 53-56

IMPROVISATION IN ORTHOPTICS—THE ROLE OF AN ORTHOPTIST IN THE ASSESSMENT OF THE MULTIHANDICAPPED, VISUALLY IMPAIRED CHILD

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Abstract

This paper describes the orthoptist's role in the assessment of visual problems in the multihandicapped, blind child.

This role has included modifications of standard testing procedures as well as tests specifically designed for multihandicapped children. The importance of the orthoptist in group discussions and planning programmes is emphasised.

Key words: *modifications, group discussions, programmes, vision tests, innovative methods.*

The Royal N.S.W. Institute for Deaf and Blind Children has employed an orthoptist in the Special School for Multihandicapped Blind Children since January, 1984.

The special school has one hundred and seven (107) students. All of the children have some form of visual impairment; some have physical and/or hearing impairment and they all have an intellectual impairment. The children have a teaching ratio of one teacher or teacher's aide to two students. There are also physiotherapists, welfare workers, a speech pathologist, speech teacher, psychologist, occupational therapists, music teacher, physical education teacher, orientation and mobility instructor and an orthoptist.

The role of an orthoptist includes assessment of visual function, research and documentation of the children's disabilities, arranging a quarterly clinic for the visiting honorary ophthalmologist, applying for blind persons' travel permits and taking some children for outside ophthalmological appointments and to OPSM for filling of spectacles. This role has been extended even further to include specific programmes for the young children with cortical blindness, hoping to train them to use the vision they have for orientation and mobility purposes.

Advice is given regarding classroom lighting and placement of desks, stressing that children's desks should be facing away from windows. Advice is also given as to size and colour of teaching material, stressing that objects with high contrast should be used. Explanations are provided concerning the benefit of compensatory head postures.

The Institute has an inservice training course and the orthoptist lectures on structure and function of the eye and basic abnormalities, the effects of blindness on development, and the role of an orthoptist and testing methods used.

Every week all members of the health team assess two children who are reviewed in a one-hour meeting. At the meeting everybody, including the classroom teacher, parents and

Reprints from: Miss H. Crossman, Royal N.S.W. Inst. for Deaf and Blind Children, 361-365 North Rocks Road, North Rocks, New South Wales, 2151.

Figure 1: Adapted Sheridan Gardiner board.

house parent, gives an input on the child's progress, problem areas, etc., and these are then discussed and solutions hopefully offered.

Visual acuity is the test of most interest to staff and this is then related to classroom activities. Results therefore have to relate to a teaching situation, so tests are aimed at visual functioning rather than a specific measure of visual acuity. If it is possible, a visual acuity reading is given, otherwise this is interpreted to describe the colour, size, shape of objects seen, at what distance and how this affects the method of teaching. The presence of a squint, pupil reactions and ocular movements are noted. Occasionally, response to convergence is tested, or with the more co-operative children, Lang's pen test is used.

In order to begin testing visual acuity, it is necessary to gain some idea of the standard reached in school work and the skills acquired and this is then adapted to a visual acuity test.

With deaf children of normal intelligence it is possible to use the Snellen's chart and the child uses the manual alphabet. It is necessary to learn the manual alphabet and some basic signs in order to communicate with the deaf children. Frequently it is necessary to test visual acuity at three metres or less.

The most widely used test with the higher functioning multihandicapped children is the Sheridan Gardiner with various modifications. Considering the gross arm movements some of the children have, thus making pointing difficult, a board was successfully devised (Figure 1) with individual compartments for the letters. The number is often limited to three or four, instead of seven letters.

Some children, especially the rubella children, were unable to understand a distance vision test, so this was adapted for use at near. Two or three single letter books are placed on the table and the child is handed the letters to be matched, i.e.,

Figure 2: The use of wooden blocks for vision assessment.

they place the letter on top of the single letter book. The size of letters to be matched is then reduced giving a measure of visual acuity for near. This is utilizing a skill of matching objects or pictures that the children learn.

Pigassou single pictures have proven to be useful either by a verbal response or by matching. A number of the children have either no speech or speech problems and are difficult to understand, so an interpreter is needed, the teacher. Osterrberg's pictures were used originally, however the drawings were too abstract for these children and items such as an aeroplane were beyond their experience. With the Pigassou pictures, the boy, flower and car are the most successful. The tree and house are not easily recognizable to these children.

Tests such as the Catford Drum, which require the child to fixate for longer than a few seconds, have proven to be almost impossible at North Rocks. Most of the children seem to have a real aversion to fixing on anything but lights, and there is also the factor of nystagmus, often quite marked. Also with the deaf, aphakic, multi-handicapped child it is difficult, even impossible to explain with their limited vocabulary and intelligence, "watch the spot".

If none of the above methods of testing visual acuity have been successful, more unorthodox methods have to be tried. These are for the children with no speech, poor co-operation, poor understanding and minimal attention spans. Part of the academic programme for these children involves teaching such skills as picking up and releasing objects. This skill can be adapted to act as a vision test. Using a set of wooden blocks ranging from 5 cm to 1 cm, the child is requested to pick up the block (Figure 2). Some can transfer them into a container, others hand them to the teacher, throw them or mouth them. The size and position of the block is noted and also accuracy in selecting the block. Large blocks with

an high contrast, e.g. blue on white, are used first then both size and contrast are reduced. The final block is 1 cm white on white.

Even the blocks have proven to be inadequate for some children. They do not understand or totally disregard the instructions and the blocks. It is obvious that these children can see, they are quite mobile and will locate any desired object easily; the question is how to measure their vision. Food is the next test used, ranging from smarties on a high contrast background to a low contrast background, to half a smartie, to a quarter. Sultanas on a brown table and 100s and 1000s are also used. The latter, however, present a problem in that they require good fine motor skills from the child and also they are not a familiar object and therefore are not interesting.

Reaction to occlusion is sometimes utilized. However, it is rarely needed because most of the children are noticeably monocular, either through buphthalmos, cataracts or corneal scarring.

Distance tests remains a problem. The following test originally used by Chris Ruby, orthoptist in the Child Development Unit at the Royal Blind Society, has been used with the children with more severe mental retardation, i.e. recognition of familiar people at various distances by the child running towards the person they know, and then having two people change jumpers and seeing at what distance the child recognizes this change.

There is still the problem of how to test the non-verbal, intellectually handicapped child confined to a wheelchair. There are still children at North Rocks who do not respond to any of the above mentioned tests. These are the children with poor fixation. These children need to be taught how to respond to a vision test before any degree of accuracy can be attempted. Training begins by teaching the children to fix on faces and objects and extending this to smooth pursuit and saccadic movements. Sound is also used in that the child responds by turning his/her head in the direction of a sound and fixates at the same time. From here, the child is encouraged to reach for desired objects and once he/she is reaching fairly accurately, some form of visual acuity can be established. The aim with these children is to develop their visual functioning in order to give them some form of independence. Hopefully, they will be able to use their vision for orientation and mobility purposes and daily living skills, i.e. finding the door, picking up a cup, etc.

CONCLUSION

Every child at North Rocks provides his own particular challenge and innovative methods must be adopted. No child is classified as too difficult to test; if necessary he is seen regularly over an extended period, firstly to gain his confidence and then to teach him how to do a vision test.

Although working with these children can sometimes be frustrating, it is far outweighed by the obvious benefit the multihandicapped child gains from the combined health team approach.

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READING EFFICIENCY OF VISUALLY IMPAIRED STUDENTS— REVIEW OF PILOT PROGRAM

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Abstract

A pilot program was run to determine if reading efficiency could be improved in visually impaired tertiary students. A review of these students was conducted twelve months post-training. The students were able to maintain the skills of vision training and reading efficiency for an extended period without further training.

Key words: *eccentric viewing, null point, reading efficiency, vision training.*

Visually impaired persons are able to improve their reading speed. Olsen, Harlow and Williams[1] were able to significantly increase the reading speed of visually impaired subjects following an intensive training course. Krischer and Meisen[2] have examined factors which will influence the reading speed of the visually impaired. Following from such studies a pilot program was devised to improve the reading efficiency of visually impaired tertiary students. The students underwent a program of vision training and reading skills. Reading efficiency was seen to improve Fitzmaurice and Keast.[3]

Subsequently the question remained; was this improvement able to be maintained without continued training? Fridal Jansen and Klindt[4] in their review study found such improvement could be maintained.

A review of the students involved in the training program was designed to determine if improvement in reading efficiency could be maintained for an extended period post-training.

METHOD

Subjects: The students from the Tertiary Resources Service of the Royal Victorian Institute for the Blind who had participated in the pilot program were notified for the review twelve months post-training. Of the original ten subjects two did not complete the program due to work commitments. One student has employment interstate and was not available. One student withdrew during training and has since recommenced but not completed the program. Six students presented for the review.

Procedure: The students were required to complete the Co-operative Reading Comprehension Test Form M, from A.C.E.R., Hawthorn, Victoria. This test was used for pre- and post-testing in the pilot program. In addition reading test two from the pilot program was redone as a measure of reading speed. The students were all asked to complete a questionnaire relating to various aspects of the training.

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TABLE 1
Comparison of Reading Speed Tests 1, 2, 3 and Review

Student	Reading Speed Words/Minutes per Visit			
	1	2	3	Review
A	143	124	147	182
B	55	53	71	80
C	41	53	54	75
D	177	169	160	237
E	132	138	127	161
F	145	132	145	144

RESULTS

Reading speed in words per minute is shown in Table 1. An indication of reading speed can be gained from the percentage of questions completed on the A.C.E.R. vocabulary test Table 2 and comprehension test Table 3. An indication of comprehension skills is gained from Table 4, percentage of comprehension questions answered correctly.

TABLE 2
Comparison of Pre, Post and Review Test Results

Student	Vocabulary Test % Completed		
	Pre Test	Post Test	Review Test
A	100	100	100
B	75	80	77
C	42	53	60
D	100	100	100
E	78	100	97
F	100	100	100

The questionnaire revealed all of the students had continued to use their vision training technique and to maintain their reading efficiency. Five of the six found the reading lamps useful and were either using or intending to buy one. Reading boards were of use to five of the six students, four have either obtained or are looking into obtaining one. Three of the students found the training time to be insufficient, none found it too long. All students agreed the training was useful to them.

TABLE 3
Comparison of Pre, Post and Review Test Results

Student	Comprehension Test % Completed		
	Pre Test	Post Test	Review Test
A	65	85	78
B	32	52	57
C	17	33	33
D	88	100	100
E	53	70	67
F	62	78	78

TABLE 4
Comparison of Pre, Post and Review Test Results

Student	Comprehension % Answered Correctly		
	Pre Test	Post Test	Review Test
A	62	69	57
B	83	94	94
C	100	85	90
D	75	72	83
E	72	83	75
F	92	85	92

DISCUSSION

The review has shown that reading efficiency was not only maintained but improved in some areas over the twelve month period.

Reading speed measured in words per minute was seen to improve with five of the six students (Table 1). Student F shows a small decrease of one word per minute. At the time of retesting this student was carrying a heavy reading workload and presented for testing over two lunch hours of the one week. This student may have been performing in a fatigued state and therefore not reaching optimum level.

When comparing the A.C.E.R. pre-test, post-test and review tests the percentage of questions answered gives an indication of reading speed. Table 2 reveals an increase in the percentage of questions answered by one student. Three

students remained the same, i.e. 100% of questions answered within the fifteen minutes allowed. Each of these students completed the test in less than fifteen minutes. Student A completed the test in less time at each test, i.e. pre-test 10 min. 37 sec., post-test 8 min. 20 sec., review 7 min. 30 sec., therefore indicating an increase in reading speed. Students D and F completed the review test in less than the pre-test time but greater than the post-test time. This reflects some maintenance of increased speed.

The percentage of comprehension questions answered (Table 3) indicates one student increasing in speed and three remaining the same between the post-test and review. Student D completed all questions in less than the allowed time at both the post-test and review. The time taken to complete this was a minute longer at the review test.

The difference in result between reading Test 2 and the A.C.E.R. tests may have been attributable to the skills involved. While reading Test 2 only assesses reading speed the A.C.E.R. tests require reading and a written response in the form of a tick. Transferring attention from the reading board to an answer sheet, selecting the appropriate answer and then returning to the reading board may have been reflected by a slower reading rate for some students.

Where a decrease in reading rate is noticed in both Tables 2 and 3 the decrease is only in relating the review test to the post-test result. These students were still reading at a greater rate than they had been pre-training.

Comprehension in terms of the percent of answers correct (Table 4) was shown to improve with three of the students, one student remained the same and two showed a decrease from post-testing to review. One of the students showing a decrease had more questions correct when comparing review and pre-test. Student A was the only student to show a decrease at review in relation to both pre-testing and post-testing. The three students showing an increase in comprehension had shown a decrease between pre-testing and post-testing. This improvement at review may reflect a greater mastery of vision training skills allowing full concentration on the material being read.

CONCLUSION

This review study was organized to determine if visually impaired students are able to maintain reading efficiency skills for an extended period of time post-training. The students were able to maintain an improved reading speed with some showing further improvement. Comprehension skills were also maintained and in some cases improved. The review also revealed the value of vision training skills, the use of appropriate lighting and reading boards.

Further work could be done to encourage the use of residual vision to improve skills such as writing for the visually impaired.

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Australian Orthoptic Journal 1985; 22: 61-63

THE VISUAL ASSESSMENT OF FIFTY-SEVEN MENTALLY RETARDED SCHOOL CHILDREN

JAN MOREY DOBA
Wangaratta, Vic

Abstract
Fifty seven children from the OF type class (moderate to severe mental retardation) were screened for visual and/or motility defects. The results show approximately 40% had defects which is a higher incidence than that in the average school population.
Key words: *OF type class, visual/motility defects, visual screening.*

INTRODUCTION

Throughout New South Wales visual screening of mentally retarded children is usually done by the School Medical Service of the Health Commission of N.S.W. Orthoptists are rarely employed by the Health Commission to screen these children. In 1982/83 an orthoptist was employed to assist the school medical service sister in assessing children from Wewak Street Public School, Albury. This was done because of the difficulty experienced in the past, leaving on average 20% of the children untested each year.

Wewak Street School for Specific Purposes is run by the Education Department and is a school for the OF class of children with an average IQ of less than 55, i.e. moderate to severe mental retardation. The ages of the children tested ranged from four to 16 years old and 29 males and 28 females were tested.

METHOD

The testing of the visual acuity of the 57 children was not under ideal conditions. As the examination room was not six metres long and there were difficulties experienced when trying to do the tests in the mirror, the VA tests were usually carried out in the corridor. The acuity tests used were mostly the Sheridan Gardiner linear and single optotypes as well as the Catford drum or the Stykar balls. The Catford drum was used in preference to the Stykar balls where possible, thus providing a written level of VA for teacher assessment. At first the Catford drum was not available, therefore some were tested with Stykar balls only.

Vision was tested with both eyes open (BEO) only if they were not co-operating with monocular vision testing. The cover test and ocular movements were also assessed, usually under more suitable conditions.

RESULTS

The disabilities and causes of retardation were obtained from the school files, hence a large number of unknown aetiologies.

Of the 14 Down's syndrome children tested 3 (21%) presented with a convergent squint.

Overall 23 (40%) children presented with visual and/or strabismic abnormalities including

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TABLE 1
Disabilities

Downs syndrome	14
Cerebral palsy	5
Hydrocephalus and epilepsy	4
Epilepsy	3
Dwarfism/convulsions	2
Microcephaly, congenital myotonia dystonica, brain damaged, malnutrition and neglect in infancy, idiopathic hypercalcemia, psychological disturbance with poor family background	1
Deafness	4
Undiagnosed/unknown	19

17 (30%) children with manifest strabismus; 29 (51%) children were orthophoric with VA of 6/9 or better and five (9%) children were untestable/unco-operative.

TABLE 2
Visual Acuity Tests Used

	No. of children	%
S.G. single optotypes	23	40
S.G. linear	15	26
Catford drum	8	14
Stykar balls	6	11
Untestable/unco-operative	5	9

DISCUSSION

The incidence of visual abnormalities found in this study is comparable to that found by Gardiner.[1] Brown[2] found it possible to visually screen mentally handicapped children when working in "quiet familiar surroundings with a sympathetic and patient examiner". The incidence of visual defects found by Brown is higher (64%) than found in this study but the

TABLE 3
Visual Acuity Assessment

	No. of children	%
Equal vision of 6/9 or better	18	32
1 line or less difference (no less than 6/9 in the weaker eye)	9	16
BEO—6/9 or better	7	12
2 lines or more difference between each eye	11	19
BEO—6/12 or less	7	12
Untestable/unco-operative	5	9

TABLE 4
Eye Movement Disorders

	No. of children	%	
Convergent squint	10	30	
Divergent squint	5		
Vertical squint	2		
Nystagmus	1		40
Muscle imbalance without squint	2		
Convergence weakness	3		
Untestable unco-operative	5		9
Orthophoric	29		51

incidence of squint found (28%) is comparable. Banks[3] found 69 out of 175 mentally retarded children to have squints (39%). Of these 69, 53 were convergent and 16 divergent, confirming my findings of convergent squint being more prevalent. Edwards, Price and Weisskopf[4] found the incidence of squints in the retarded child to be 35% with the incidence of eye defects as a whole increasing to 48%. The figures from this study, 30% of children with squints increasing to 40% for those having visual and/or motility defects, are comparable and highlight the need for a full ophthalmological examination to be carried out.

It is interesting to note Erby[5] found a higher incidence of squint (56%) and visual abnormalities presenting in mentally handicapped children whose IQ was generally lower than these children screened. It is also interesting to note that Eissler an Logenecker,[6] and Hiles, Hoyme and McFarlane,[7] Dunlop[8] and others in the past have found a high incidence of convergent squint in Down's syndrome children. In this study three squints, all convergent, were found in 17 Down's children.

CONCLUSION

It has been shown there is a higher incidence of eye problems in mentally handicapped children than that in the normal school population. Banks states "that the earlier and better the visual sense functions then the greater chance the child has of achieving his potential".[3] Therefore it is important for these children to be screened thoroughly. This can be achieved more accurately if the child is in familiar surroundings

with patient and sympathetic examiners, preferably two in number. It is therefore apparent that the orthoptist with his/her specialized knowledge and skills can be an important member of this team.

ACKNOWLEDGEMENTS

I sincerely thank Joan Causer from the School Medical Service for her invaluable help with the screening of these children.

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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. Tel. (02) 646 6444.

ANALYSIS OF THE AC/A RATIO IN A SAMPLE OF INTERMITTENT EXOTROPES OF DIVERGENCE EXCESS TYPE—**Carolyn Smith**

Literature proposes that many of the patients diagnosed as intermittent exotropes of divergence excess are, in fact, simulated forms of this condition. It is suggested that some of these patients control an equally large near deviation by excessive accommodative convergence and possess a high AC/A ratio. In order to investigate the type of AC/A ratio present amongst a sample of seventeen intermittent exotropes of divergence excess the AC/A ratio was calculated by the gradient method at 1/3 m using +3.00 DS lenses. An equivalent normal sample was also investigated. When comparing the two groups the intermittent exotropic sample had a significantly greater proportion of high AC/A subjects. Disclosure of a high AC/A ratio is valuable when considering orthoptic and surgical management of the intermittent exotrope of divergence excess.

A COMPARATIVE STUDY OF BIMEDIAL RECTUS RECESSION AND RECESSION-RESECTION PROCEDURES IN EARLY ONSET ESOTROPIA—**Poppy Mitropoulos**

The bimedial rectus recession procedure was performed on eighteen children with early onset esotropia, and the recession-resection procedure was performed on twenty one children with early onset esotropia. This study assessed the effectiveness of each procedure on reducing the horizontal deviation. Comparison of the two procedures showed the bimedial rectus recession procedure to be more effective than the recession-resection procedure both immediately post-operative, and with the one year follow up period. However, neither procedure was effective enough to align the eyes adequately for functional reasons. Also, in the study, post-operative assessment of inferior oblique over actions, dissociated vertical deviation (DVD), nystagmus and vertical deviations were assessed even though these were small in number. Gillies theory that vertical deviations, measuring less than four prism dioptres, disappeared with horizontal muscle surgery alone was also considered, however results of this study do not support Gillies theory.

SACCADIC, SMOOTH PURSUIT, OPTOKINETIC NYSTAGMUS DEFECTS OF MIDDLE CEREBRAL ARTERY CVA—**Liane Walker**

Of twenty three middle cerebral artery (MCA) stroke patients at Lidcombe Hospital examined for smooth pursuit, saccadic and optokinetic nystagmus (OKN) defects, eight (34.8%) of patients were found to have such defects.

Common defects presenting were:

1. subtle defects only of saccades to the contralateral side of the MCA lesion.
2. cogwheeling or saccadic pursuit to the same side as the MCA lesion.
3. the response to OKN being defective to the same side as the lesion.
4. a defect of vertical OKN in both elevation and depression.

THE INFLUENCE OF EARLY ONSET ESOTROPIA ON THE DEVELOPMENTAL MILESTONES IN INFANTS—**Sonia Biondi**

Developmental milestones were assessed in twenty-two infants using a questionnaire based on eighteen abilities. The infants assessed were aged between fifteen and thirty-six months. The twenty-two infants were divided into two groups, each comprising eleven subjects. Group 1 comprised the control group and Group 2 comprised infants with an early onset esotropia. Group 1 and Group 2 were compared to a standardised normal group, and it was found that both groups achieved an earlier standard than the standardised normal group, with the strabismic group performing milestones a little earlier than the control group. This may have resulted from parents not wanting their strabismic children to appear delayed.

THE EFFECT OF PRESS-ON PRISMS ON VISUAL FUNCTION—**Jacqueline Spargo**

Fresnel press-on prisms are used widely in orthoptic practice for both diagnosis and management of constant, intermittent and latent strabismus. They have a number of advantages but the main disadvantage is reduction and distortion of vision. 20 normal subjects were tested with respect to visual

acuity and stereoacuity while wearing press-on prisms of various size bilaterally. 10 subjects who were wearing press-on prisms to correct a deviation were asked by questionnaire about the problems encountered related to prisms. Press-on prisms were found to reduce 6 m visual acuity slightly more than near visual acuity and stereoacuity was reduced when worn bilaterally. This reduction was proportional to the prism size. Prism wearers experienced most problems with light reflections off the prisms and judging distances. Symptoms of eye strain were experienced by two subjects wearing prisms bilaterally. Patients should be advised of the problems which may be encountered when wearing press-on prisms.

NEAR VISUAL ACUITY—SINGLE LETTERS VERSUS LINEAR—**Kathryn Mychael**

In this study 40 subjects were assessed—20 orthoptically normal subjects, and 20 amblyopic subjects. The near visual acuity was assessed using linear test-type and single letter test-type. The differences in acuity between methods is observed and discussed. The results show that there is a significant difference between linear and single letter near visual acuity in amblyopic eyes. This is also true of normal eyes, but to a much lesser degree. Reasons for this 'crowding phenomenon' in amblyopic subjects are discussed, and suggestions for the use of this information in diagnosis and treatment are put forward.

THE EFFECT OF ILLUMINATION, AND OTHER VARIABLES ON TNO RESULTS—**Liane Smith**

Twenty two patients, whose ages ranged from seven to seventy-three years, were examined with the TNO stereotest under five different illuminations. The variables of age, visual acuity, convergence near point and illumination on TNO results were assessed and analysed. The results indicate that neither convergence near point, visual acuity or age significantly correlate to TNO stereoacuity levels. Illumination was found to be a statistically significant variable affecting TNO results.

STEREOACUITY WITH INDUCED ANISOMETROPIA—ARE CYLINDRICAL DIFFERENCES MORE SIGNIFICANT THAN SPHERICAL?—**Jannine Shahady**

Anisometropia was induced in twenty normal subjects to assess whether cylinders had a greater effect than spheres on reducing stereoacuity. It was found that spheres (which simulate overall anisometropia) proved more debilitating to stereoacuity than cylinders. However, results for simulated horizontal astigmatic anisometropia were very similar to those for overall anisometropia. Simulated vertical astigmatic anisometropia was found to be the least disruptive. It is suggested that the reason for this lies in the fact that binocular vision is actually the cortical integration of two horizontally disparate images and, therefore, stereoacuity is perhaps most sensitive to an image that has horizontal blur. Several possible clinical applications are also discussed.

STANDARDISED COLOUR PERIMETRY ON SUBJECTS WITH NORMAL AND CONGENITALLY ABNORMAL COLOUR VISION—**Valerie Tosswill**

Colour perimetry was performed on sixteen subjects—ten with normal colour vision and six with congenitally abnormal colour vision (anomalous trichromatic vision, as determined from Ishihara Plates)—using the Goldmann Perimeter. Four isopters were plotted for each subject using 112e white, 112e red and 114e red targets, all three giving achromatic isopters and the fourth also producing a chromatic isopter. For all fields, those of the colour defect group were smaller than the normals, with their red field falling within the area of maximum cone concentration. The photometrically calibrated 112e white and 114e red targets gave similar achromatic fields in colour normals only, with the chromatic isopters of this group falling well beyond the area of greatest cone concentration. The colour defect group also displayed a significant reduced sensitivity to the introduction of a red filter over the 112e white target.

THE ACCURACY OF NEAR VISION TESTING—**Donna Jones**

Near visual acuity was tested on twenty subjects with equal vision, and eleven subjects with amblyopia. A Reduced Snellen's chart, designed for use at thirty-five centimetres was used and near vision was tested on each subject at the following distances: thirty-three centimetres, thirty-five centimetres and at a distance subjectively chosen, to see whether any difference could be found in acuity at these distances. When subjects with equal vision were tested, no significant difference was found when the testing distance was varied, however, in amblyopic subjects, six subjects showed the same response at each distance, while in four subjects, visual acuity appeared to be of a higher value when tested at the subjectively chosen distance, and lower when tested at thirty-five centimetres. One subject showed a lower visual acuity at the subjectively chosen distance.

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,
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625 Swanston St.,
Carlton, Vic. 3053.
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A STUDY OF THE AP DIAMETER IN GLAUCOMATOUS EYES—**Carmen Agnew, Margaret Allen, Ellen Boag, Wendy James, Karen Jesse, Geraldine McConaghy, Linda McKenzie, Lin Mulhall, Sandra Penso, Renata Sirotic, Moira Tangney, Kim Windsor**

The anteroposterior (AP) diameter of twenty new patients at the RVEEH Glaucoma Investigation and Research Unit (GIRU) was measured by A-scan ultrasonography. The diagnosis and classification of glaucoma in these patients was known prior to the study. This research included all types of glaucoma, in an aim to further study if any significant difference exists between glaucomatous and non-glaucomatous eyes with respect to AP diameter. With the exception of a highly significant correlation in the AP diameter between the right and left eyes, no significant correlations were found.

OBITUARY

ALISON SYME

It was fortunate for the development of orthoptics in Victoria that Alison Syme was appointed head of the orthoptic clinic at the Victorian Eye and Ear Hospital in 1947. She was truly a gentlewoman, gentle with a strong sense of duty and a lively interest in people whereby she won the respect of medical staff and people in all departments. Over the years, as hospital, clinic, and orthoptic staff increased, her work was mainly administrative. She contributed papers on pleoptics in the Orthoptic Journal in 1961 and 1962, and collaborated with Dr Gillies in a further pleoptic paper published in the British Medical Journal.

After 25 years at the Royal Victorian Eye and Ear Hospital she resigned from the clinic, but for a few years more worked in an ophthalmological private practice.

With no warning, she died, peacefully, on 8th November, 1984, at her brother's home. Alison will be remembered as a staunch, dryly humorous and loved friend by orthoptists and many others.

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