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EDITORIAL

The variety of subjects presented in this edition of the Australian Orthoptic Journal reflects the nature of contemporary orthoptics.

The orthoptist to-day undergoes a training which incorporates lessons learnt from the past as well as knowledge of current concepts and the use of modern technological methods. The result is exemplified by the paper awarded The Emmie Russell Prize for 1982, an award limited to graduates of five years or less, to which the reader's attention is drawn.

So too has the practising orthoptist been able to keep up to date through continuing education programmes and scientific seminars, thus enabling her/him to supply a useful service to the ophthalmologist and the community.

However the value of the modern orthoptist can only be appreciated if the extent of her capabilities are understood. It is hoped that this journal will help to bridge that gap in understanding which has arisen through the progress made in the last decade or so.

Margaret Doyle



Retiring Editor, Mrs Diana Craig, at a dinner given in her honour by the Victorian Branch of the O.A.A., with recently elected Honorary member, Dr W. E. Gillies.



Recipient of The Emmie Russell Prize for 1982, Miss Anne Fitzgerald, with Past-President Mrs Marion Rivers.

PSYCHOLOGICAL CORRELATES OF ACCOMMODATIVE SQUINT

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Abstract

The aim of this study was to determine whether certain psychological variables are distinct characteristics of children suffering from accommodative squints. Thirty children who have been diagnosed as suffering from accommodative squint, thirty other orthoptic patients and thirty control children were tested with psychological and physiological tests.

On the Rosenzweig Picture Frustration Study, children with accommodative squint showed greatest tendency to turn their aggression onto the environment and they showed least tendency to gloss over frustration.

On the Bristol Social Adjustment Guide, it was found that they had to a statistically significant degree a readiness to overreact to everyday situations.

Heartrate measures were taken under slightly stressful conditions. Only children with accommodative squint showed a consistent, statistically significant increase in their heartrate.

The influence of the above findings is tentatively offered as an implicating factor in the aetiology, prognosis and treatment of accommodative squint.

Key words: *Psychological tests, physiological test.*

INTRODUCTION

Squint is present in 3% of children.¹ Convergent squint is the most common type of squint. One third of these are accommodative squints. The investigator reviewed the case histories of all the children with convergent squint who have been seen by her over a number of years. It has been found that, of those who had been discharged as apparently cured following successful treatment, 20% sought further help at a later date. This was provoked by periodic loss of control over their deviation. On further analysis, this group proved to be entirely composed of those children who clinically were classified as suffering from an accommodative type of squint.

The investigator's 30 years subjective clinical impression was that these children presented the picture of an emotional, nervous, fidgety, extroverted, overreactive, cooperative youngster who welcomed a challenge and appeared to live in a more frequently stressful environment, with strict, more demanding parents than other patients. This suggested the possibility that psychological correlates contribute to the prognosis and aetiology of accommodative squint. This notion is supported by numerous statements of authorities without any empirical research to support the premises.

The aim of this study was to determine whether certain psychological variables are distinctive correlates of children diagnosed as

This paper is a condensed version of a thesis submitted in partial fulfilment of the requirements for the degree of Master of Arts at the University of Sydney.

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having accommodative squint. Well recognised and previously documented aetiological factors, such as refractive error, AC/A ratio, heredity, anatomical factors (of central nervous origin), and developmental deficits, are not considered in this paper.

The possibility of psychological factors being related to squint has been specifically considered in a number of published articles. Many are concerned with psychological effects of squint on a child, but very little on the reverse which is the primary concern of this paper, that is that psychological factors may play a part in the aetiology and prognosis of squint. References to emotional or psychological factors in the ophthalmic literature, are mostly statements of the authors' casual observations. There is no precise explanation of the nature of these factors and how they exert their influence.

Gesell's (1949)² observations about the age accommodative squint usually develops are relevant. Describing the visual development of the normal infant he states:

"It is an extraordinary fact, that as a child approaches the 2½ year level of maturity, he may sometimes look with such overpowering intensity, that his legs collapse under him."

In this statement the significant word is intensity, because, depending on the child's incentive motivation this intensity can have varying levels.

Parson (1947)³ mentions a tendency to selfconscious mannerism and precocious interest in the minute, even before accommodative convergence relationships have been established.

Clement and Jackson (1972)⁴ found that accommodative factors are much more important as a causative factor in children of higher social class parents.

PREDICTIONS AND INVESTIGATION

The extent to which there is professional agreement regarding the hypothesis, that there are psychological correlates in the aetiology and prognosis of accommodative squint, was examined. A questionnaire containing a list of descriptive characteristics that might be typical of children suffering from accommodative squint

was sent to orthoptists throughout Australia. The somewhat arbitrary nature of selection of these characteristics was a practical necessity.

Based on the data from these questionnaires (36 returned), on the literature reviewed and the investigator's clinical observations, predictions were made which also provided the rationale for selecting the following tests:

1. *Junior Eysenck personality inventory*: chosen because it purports to measure extroversion/introversion, a characteristic attributed to children with accommodative squint. The specific prediction was that children with accommodative squint will score higher on extroversion compared with other children because they are more sociable, lively, impulsive and talkative.

2. *The children's form of The Rosenzweig Picture-frustration study*: represents a limited projective procedure, and was chosen because it claims to disclose certain patterns of responses of children to every day stress.⁵ The technique is derived conceptually from the principles of frustration theory⁶ (Rosenzweig, 1976) and has been standardised world wide.

Orthoptists found, according to the questionnaire sent to them, that children with accommodative squint seemed to be tense, worrying about everything, persevering, and hyperactive. Rosenzweig (1976) writes that:

... he conceives of frustration whenever an organism meets a more or less unsurmountable obstacle or obstruction to its route to satisfaction of vital needs.

The investigator feels that blurred vision would be conceived by children as such an obstacle. The more so, as Rosenzweig points out, that when such stress occurs, aggression of some type ensues. The experimenter feels that over-accommodation and over-convergence could be regarded as expressions of "aggression". Rosenzweig conceives of aggression in a broader sense than most other writers. Significantly, he does not see it as just a negative or destructive quality.⁷

The specific prediction was that children with accommodative squint will score higher on extra-punitiveness (the frustrated individual shows aggression towards the source of frustration) than other subjects. That is, they will turn their aggression onto the environment. Equally they will score higher on Obstacle-Dominance than other subjects, because they will be very concerned with the barrier occasioning the frustration and they will face up to obstacles and react upon them. However, they will score lower on impunitiveness (the individual denies the frustration) than other subjects, because they do not choose to gloss over frustration or evade it.

3. *Heartrate measures:* under slightly stressful situations have been included on the assumption that they reflect degrees of tension produced by situations perceived as stressful or frustrating. They are physiological indicators of autonomous nervous system activity and as such, have often been used as clues of transitory anxiety. Heartrate measures are objective and easy to quantify.

To create a stressful situation, that would be acceptable to the hospital setting, and applicable to the age range from five to 13 years, it was decided to ask mental arithmetic questions in ascending difficulty, from the subjects. The questions were fired at the child starting with one level below their respective classroom requirements and continued up the grade till three consecutive questions were failed. To standardise the procedure, questions from the "DUX"⁸ Series Mental Arithmetic, were used. This book is a standard textbook in many New South Wales primary schools.

It was predicted that under the above conditions children with accommodative squint will show a more marked increase of their heartrate per second than the other subjects, because they show more exaggerated responses to stressful situations than other children.

4. *The Bristol Social Adjustment Guide:* represents an instrument which purports to give an all-round picture of a child's personality. It offered firstly a method of assessing a wide range of the child's behaviour (in comparison with normal children in a non-hospital setting), and attitudes as they are seen over a period of time by their teachers. Secondly, it furnished some data for the assessment of the relationship between the child and his family: and it was felt that this would provide an adjunct to the information obtainable from the Parental Attitude Research Instrument.

The special prediction was that children with accommodative squint will be coming from a more unstable family than other children, therefore they will score higher on the F (family) scale than other subjects. As they appeared to be more impulsive, aggressive, emotional, excitable, children with accommodative squint will tend to overreact to situations more often than other subjects, hence will score high on the overreaction component.

5. *The Parental Attitude Research Instrument:* In this the investigator was mostly interested in the Achievement pressure component. Before this study was undertaken, the author was under the impression that children with accommodative squint were under more unfavourable family circumstances (not economically speaking) and especially that they were under greater pressure from their parents to excel in all their intellectual activities. Therefore, the specific prediction was that children with accommodative squint will have parents who score higher on this component than other parents, because these parents appeared to demand high standards — they showed a "no nonsense attitude" towards the child. Secondly, this impression seemed to be supported by Clement and Jackson's (1972) study, who concluded that children with accommodative squint were under greater pressure from their parents to excel in reading and writing, than other children. Thirdly, orthoptists tended to confirm this view, on the questionnaire.

SUBJECTS

A total of 196 eye patients were contacted by telephone or letter. The final number of participants was elected to be 90 children (30 in each group). The choice of equal numbers in each group was made on statistical grounds.

The age of the children ranged from five to 13. (This age limit was dictated by the Junior Eysenck Personality Inventory and the Rosenzweig Picture Frustration Tests, which are designed for this age range.) The eye patients were randomly selected from the orthoptic department of Sydney Eye Hospital (University of Sydney) and Prince of Wales Hospital (University of New South Wales) and the experimenter's private practice.

One group comprised children who have been diagnosed as having accommodative squint (14 boys, 16 girls, including five pairs of siblings). Another group comprised children who attended the clinics for eye-complaints other than accommodative squint (15 boys, 15 girls). This group was included in the design to eliminate any effect which eye treatment, wearing of glasses, occlusion or eyedrops might have and so could confound the test results on the accommodative squint group. The third group (control) were children without any medical problem and who did not attend any clinic for treatment (16 boys, of whom eight were siblings of patients and eight were children of friends; and 14 girls, of whom six were siblings of patients and eight were children of friends). Each child was tested individually, with the accompanying parent.

PROCEDURE

For each subject an individual appointment was made, at the orthoptic clinic. It was explained that they would be doing two paper and pencil tasks; and one mental arithmetic task while their heartrate would be recorded. It was strongly emphasised that the paper and pencil tests were only to be seen by the experimenter, that the mental arithmetic questions were quite unrelated to their school marks. As an incentive to ensure cooperation each child was promised a small present at the end of the test if they did their best. All of them were rewarded. The ones who could

not read and write were helped, by the examiner reading out the questions and writing down the responses.

For the heartrate measures two disposable electrodes (DRACARD) with neptic electrode gel were used. One electrode was placed at the center of the manubrium section of the sternum, and the other directly below the nipple, at the same level as the xiphoid process on the sixth rib. A bio-telemetry FM transmitter (Devices Model SNR 102F) was attached to the electrode leads. Transmission of the heartbeat was picked up, and recorded by an FM radio cassette recorder (National FM/AM radio cassette recorder 444). This sound recording was later transposed to a graph paper, by courtesy of OPSM hearing aid department, to facilitate accurate counting of the heartbeat recordings. The recording was commenced after the experimenter was satisfied that the heartbeat was coming through satisfactorily. As soon as this was established the mental arithmetic questions were fired at the children. While the experimenter attached the electrodes to the children, she explained to each subject that she will be asking them some mental arithmetic questions, that were not too hard, that children their age could all easily answer them, and that they should answer as fast as possible, to see how many questions they could answer correctly in the shortest possible time. When they began to miss questions, they were spurred on by remarks such as: "I am sure you can do this, just try a bit harder, come on hurry up", etc. The questioning was continued till three consecutive questions were beyond the scope of the subject.

The length of time recordings were taken depended on the time an individual subject reached his level of three wrongly answered questions, therefore the individual recorded times were not uniform. By this time some parents had the Parental Attitude Research Instrument completed. The Bristol Social Adjustment Guide Form for the family was then discussed and completed. The Bristol Social Adjustment Guide's School form was handed to the escort of the child, together with a stamped envelope, with the request to deliver it to the

child's teacher. By asking the parent to hand the questionnaire to the teacher the problem of "consent" was solved.

ANALYSIS OF DATA

For all the reported measures, the procedure was to apply an analysis of variance, then if the null hypothesis was rejected planned contrast was done. All the data treatment was orthogonal, except the heartrate data. On the heartrate data the experimenter was looking for increase in heartrate, per second within subjects as compared to between subjects.

DISCUSSION

On the basis of this research, it is found, that children with accommodative squint are not more extroverted and nervous; they do not live under more stressful situations and they do not have stricter parents than other children. However statistical evidence confirmed that children with accommodative squint are more extrapunitive, less impunitive and have a marked tendency to overreact to every day situations and they do increase their heartrate more than other subjects under stressful situations.

This revised "picture" of the child with accommodative squint is based on the following findings:

- (1) Although some extroversion characteristics seemed to apply to children with accommodative squint (sociability, activity, out-going behaviour, etc.) this was not confirmed. Statistical findings on the Junior Eysenck Personality Inventory indicate that the three groups of children tested, did not differ on these measures. This negative result of the measure of neuroticism is further supported by the results of the BSAG's neuroticism component.
- (2) On the Picture-Frustration study statistical results led to the acceptance of the null hypothesis on Obstacle-Dominance. Prior to these findings, the investigator expected that children with accommodative squint will score highly on Obstacle-Dominance. This line of reasoning derived from the statements

made in the ophthalmic literature, where these children are described as having precarious interest in the minute and are persevering, nervous, etc.

- (3) The null hypothesis is rejected on measures of extrapuniteness and impunitiveness. The results of the planned contrast showed that children with accommodative squint showed least tendency for impunitiveness and greatest tendency for extrapuniteness. Consequently, the predictions on these two scores have been confirmed because both scores showed a statistically reliable difference, in the predicted directions, between children with accommodative squint and other subjects. That children with accommodative squint were least ready to gloss over frustration in an attempt to evade aggression, and showed the greatest readiness to turn their aggression onto the environment, means in more specific terms, according to Rosenzweig's interpretation, that the high extrapunitive score and the low impunitive score of children with accommodative squint is consistent with their uninhibited extrapunitive aggression; that is, they express aggression against the environment and are unwilling to gloss over frustration without apparent aggression; they do not elect to rest at the stage of ego defense.

In line with Rosenzweig's interpretation the investigator is tempted to deduce that children with accommodative squint, by not being resigned to a blurred environment, search for ways to solve their dilemma with means available to them. By not being prepared to gloss over this frustration they exert accommodation and convergence. In other words, children with accommodative squint are not prepared to give up clear vision for binocular, single vision "without a fight". This, partly brings the problem back to the classical dilemma of the hypermetrope: "If he accommodates sufficiently to see clearly, he will overconverge; if he converges normally, he will accommodate insufficiently" (Huggonier).⁹

- (4) As predicted, children with accommodative squint showed a consistent, statistically significant increase in their heartrate per second throughout the testing period. This is interpreted, therefore, as showing an overall change to a higher level of physiological measure of frustration in children with accommodative squint. This may imply that the threshold of what appears to be stressful is much lower in children with accommodative squint than in other children. If that is so, then it can be argued that they react to threats to the clarity of their vision at a level where other children, under comparable situations, do not feel disadvantaged or threatened yet.
- (5) As predicted, a statistically significant difference, as seen by their teachers, was found between children with accommodative squint and children with eye disorders, in relation to their reaction to every day situations. Children with other eye disorders showed greatest tendency to underreact, and children with accommodative squint, to overreact. This finding, that children with accommodative squint showed a most pronounced tendency to overreact to every day situations, seems to be supported by the finding on the Rosenzweig Picture-Frustration study.
- (6) A surprisingly unexpected result of the study was the finding that the three groups did not differ either on the Parental Attitude Research Instrument nor were children with accommodative squint affected by more adverse factors in the family than other children, as indicated by the results of the Bristol Social Adjustment Guide. This is contrary to the expectation, that children with accommodative squint are under greater pressure from their parents to excel in all their activities, which was fuelled by the Clement and Jackson⁴ finding, by the response to the orthoptists' questionnaire and by the experimenter's subjective observations.

An interesting by-product of the research were two findings:

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- (a) The heartrate chart of the children with no eye disorders showed no change under slightly stressful conditions.
- (b) Children with eye disorders showed a statistically significant underreaction to every day situations.

The question arises, could this be due to the seven (23 1/3 %) intermittent divergent squint cases included in the eye patient group? The literature frequently refers to these children as "day dreamers", easy going, placid children. Are they in some way the opposite to children with accommodative squint? Perhaps a future study will shed some light on this.

RESULTS

The stimulus to accommodate in hypermetropic accommodative squint is initiated by blurred vision. It is the individual child's own accommodative effort, made to overcome the blurred vision, which determines the convergence response. The important point demonstrated here is that the more easily frustrated child will have greater motivation to seek a solution to his problem within his repertoire in order to improve his optical resolution.

The most significant results of this study, from a practical point of view are:

- (a) that children with accommodative squint react to stress more readily and more vehemently than their peers as confirmed by the heartrate measures, compared with other children.
- (b) that children with accommodative squint showed greater readiness to overreact to every day situations as compared to other children, as confirmed by the Picture-Frustration study and BSAG.
- (c) that children with accommodative squint are not under more stressful family circumstances and are not under more achievement pressure compared with other children, as found by the PARI and BSAG.

It is realised that due to limitations this study touched only on a few possible psychological variables and further studies, with a wider scope, will probably identify more correlates of accommodative squint.

CONCLUSION

The present study was carried out to support with empirical evidence the premises that certain

psychological variables are distinct correlates of children suffering from accommodative squint. Statistical evidence confirms that in this study children with accommodative squint are more extropunitive, less impunitive, overreact to every day situations and increase their heartrate under mild stress more than other subjects.

However, no difference was found on extroversion, neuroticism, family circumstances and achievement pressure.

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THE OKN RESPONSE AND BINOCULAR VISION IN EARLY ONSET STRABISMUS*

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Abstract

Asymmetry of uniocular opto-kinetic nystagmus (OKN) occurs when a normal response is elicited by moving the targets in a temporal-nasal direction but not by moving them in a nasal-temporal direction. This finding has been reported in normal infants and in those with congenital esotropia.

In this study OKN has been investigated in 69 patients with early onset strabismus and in 25 patients with later onset strabismus. Asymmetry has been found only in those with strabismus, nystagmus and dissociated vertical divergence (DVD) and not in other patients with early or later onset strabismus. Although superficial binocular vision was found in some cases it was insufficient to maintain peripheral fusion.

Key words: *Dissociated vertical divergence, opto-kinetic nystagmus, nystagmus, congenital esotropia.*

INTRODUCTION

Early onset strabismus is defined as a manifest deviation present at birth or occurring within the first six months of life. This paper is based on a further study of patients in two series previously reported. Series 1 comprised 100 patients with early onset strabismus and dissociated vertical divergence (DVD) and was presented at the 4th International Orthoptic Congress (Mein and Johnson 1981);¹ 88 patients were esotropic and 12 exotropic, all had nystagmus. Series 2 comprised 130 consecutive patients with early onset esotropia who were currently attending the Orthoptic Clinic at the General Infirmary at Leeds: these patients were studied to assess their characteristics, the incidence of nystagmus and DVD, and their natural history. The results were presented at a meeting of the Consilium Europaeum Strabismus Studio Deditum (CESSD) in 1981 (Harcourt and

Mein 1982).² From this study three groups emerged:

Group 1 Esotropia + nystagmus + DVD	43
Group 2 Esotropia + nystagmus - DVD	13
Group 3 Esotropia - nystagmus - DVD	74
	<u>130</u>

Group 1

The main characteristics of patients in this group were:

1. large angle esotropia with crossed fixation in nearly all cases.
2. early presentation; the average age when first seen was 10 months.
3. jerky horizontal nystagmus with the fast phase to the uncovered eye. Nystagmus appeared latent in the majority but 30% of patients seen in infancy in Series 1 had manifest nystagmus on presentation, usually rotary or with a rotary component,

* This work was supported by a grant from the Mary Marsh Fund, Sussex Eye Hospital, Brighton. The paper was presented in April, 1982 at the Sydney Eye Hospital Centenary International Scientific Meeting.

which gradually changed to the horizontal nystagmus more typical of the condition. According to Dell Osso *et al* (1979)³ this nystagmus should be classified as manifest latent since no patient had binocular single vision.

4. gradual onset of DVD between the age of 18 months to three years, with a few later exceptions.
5. a face turn to the side of the fixing eye with or without a head tilt. We believe that the face turn is adopted to compensate for nystagmus rather than limited abduction.
6. a preponderance of A pattern.
7. poor or no binocular vision.

Group 2

Approximately half the patients presented with the same characteristics as those in Group 1 except that they did not develop DVD. It is possible that the younger patients will still do so. The remaining patients presented with smaller and often variable unilateral strabismus. A compensatory head posture and poor binocular vision were the rule.

Group 3

The main characteristics of patients in Group 3 were:

1. smaller angle esotropia, usually unilateral, with consequent amblyopia.
2. later presentation, averaging two years four months when first seen, probably because of relatively good cosmesis.
3. no compensatory head posture.
4. a slight preponderance of V pattern (26), although the incidence of A pattern was high (23).
5. poor or no binocular vision in all but seven patients.

It was impossible to prove the early onset in all cases and it is probable that a few patients with early pseudo-strabismus developed a true strabismus later. The history is supported by the poor binocular vision found in 67 patients.

Recently Kommerell (1978)⁴ stated that another characteristic of congenital esotropia is asymmetry of optokinetic nystagmus (OKN)

when tested unocularly. When the stripes of a drum or scarf are moved in a temporal to nasal direction a normal response is elicited but when they are moved in a nasal-temporal direction there is no response or only weak irregular saccades.

A similar finding has been reported in normal infants under the age of three to four months by Atkinson (1979).⁵ She states that it is likely that symmetry of OKN provides an indicator of the maturation of the binocular cortex and suggests that OKN may be usable as a test for anomalies of binocular development.

Recent papers have suggested that peripheral or even central fusion can exist in patients with strabismus and DVD. Sprague *et al* (1980)⁶ stated that peripheral fusion will control the deviation once the horizontal angle is corrected. Helveston (1980)⁷ found fusion for near using Worth's four-dot test in 23% of 111 patients, but could demonstrate fusion for distance in only one patient. He reported gross stereoacuity (Titmus fly) in 9% and a weak fusion range on the major amblyoscope in 7%. Cohen and Moore (1980),⁸ reporting on primary DVD unassociated with other forms of strabismus, found peripheral fusion in 15 out of 23 cases and central fusion in one patient. In Series 1 we found evidence of superficial abnormal retinal correspondence (ARC) using Bagolini striated glasses in 23% but were unable to substantiate anomalous fusion in any other test. Only 2% of our patients claimed to see the Titmus fly stereoscopically. We did not consider these responses constituted useful peripheral fusion.

AIMS OF PRESENT STUDY

Because of this discrepancy and to assess the significance of the OKN response in relation to binocular function it was decided to investigate OKN and re-evaluate binocular vision in available patients in the two series and in new patients with early onset strabismus.

METHODS

1. OKN

Horizontal OKN was first tested with both eyes open using a hand-held drum, moving the stripes

in each direction. OKN was then tested with each eye in turn, moving the stripes first temporal-nasal and then nasal-temporal, repeating the manoeuvre several times. Occasionally it was easier to hold the attention of a young child by using a scarf instead of a drum.

2. Binocular vision

Binocular vision was assessed using

- (a) Bagolini striated glasses for near and distance.
- (b) Lang's 2-pen test.
- (c) stereoacuity test, TNO if possible.
- (d) 15 Δ or 20 Δ base out prism to assess motor fusion.
- (e) major amblyoscope to diagnose retinal correspondence and fusion.

These tests were chosen because, with the exception of the major amblyoscope, they are simple and non-dissociating.

PRELIMINARY RESULTS

Sixty-nine patients with early onset strabismus have been tested grouped as in Series 2 but including some patients with exotropia. A control group of patients with later onset strabismus has been added and a small number of patients with nystagmus who maintain binocular single vision (BSV) has been assessed, making a total of 99 patients divided into five groups:

Group 1 strabismus + nystagmus + DVD	34
Group 2 strabismus + nystagmus - DVD	17
Group 3 strabismus - nystagmus - DVD	18
Group 4 later onset strabismus	25
Group 5 BSV + nystagmus	5
	<hr/>
	99

Results of OKN testing

Group 1

When the stripes were moved temporal-nasal all patients showed a normal response. When the stripes were moved nasal-temporal no patient showed a normal response, either nystagmus was absent or weak intermittent saccades were seen. This occurred whether latent (or manifest latent) nystagmus was obvious or minimal. Latent

nystagmus was not demonstrable in the primary position in two patients but one, included in Series 1, was known to have had latent nystagmus in the past. The second patient, aged nine years, remained in the group because nystagmus could not be excluded in the absence of EOG studies. All patients showed a normal response when tested with both eyes open.

Group 2

No clear cut pattern emerged. Five patients showed the same response as those in Group 1, four are still young enough to develop DVD. Four patients with latent nystagmus showed a normal response. Eight patients showed a variety of responses, OKN was reduced in both directions, more reduced on temporal-nasal movement or was, e.g., consistently better on R. gaze with either eye. Further study is needed to determine the exact nature of the nystagmus in each case.

Groups 3 and 4

There was a normal response in all but one patient in each group. Both patients showed a reduced response in a severely amblyopic eye.

Group 5

Normal OKN was elicited in two patients. It could be demonstrated in the remaining three patients when the fast phases of nystagmus and OKN coincided but was reduced in amplitude in the opposite direction. All three were albinos with severely impaired vision.

The youngest patient tested was 18 months of age. Problems in eliciting OKN were encountered if the visual acuity was less than 6/60.

Binocular vision

Group 1

Six patients showed a superficial ARC (Bagolini glasses and a crossing angle on the major amblyoscope) but only three demonstrated a weak fusional response to a prism. No patient had stereopsis. Eight now have consecutive exotropia.

Group 2

Two patients showed superficial ARC, none demonstrated motor fusion or stereopsis. Four have consecutive strabismus.

Group 3

Two patients showed ARC, one demonstrated a weak fusional response and three had some stereopsis. Five have consecutive strabismus.

Group 4

Binocular vision varied from good (60" stereoacuity) to non-existent.

Group 5

The presence of BSV was proven in all cases. The poor binocular responses and the high incidence of consecutive strabismus do not support the view that there is sufficiently strong peripheral fusion to control the residual deviation in early onset strabismus.

DISCUSSION

Animal studies suggest that temporal-nasal movement can be controlled by a direct pathway from the retina to the pretectum but nasal-temporal movement requires a more advanced pathway via the cortex (Hoffmann 1979).⁹ The fact that human infants demonstrate temporal-nasally induced OKN three months before nasal-temporal OKN suggests that two pathways may exist in man. Kommerell (1978, 1982)^{4,10} has proposed that OKN remains at an atavistic level in congenital esotropia and that this is a factor in the production of nystagmus. He suggests that these patients can be compared with animals lacking binocular stereopsis, for example the rabbit, which shows the same asymmetry of OKN (Collewijn 1975).¹¹

In the rabbit and in other non-binocular animals both nasal and temporal retina are represented in the contralateral cortex. It is now established that up to 20° of temporal retina in albino animals such as the Siamese cat is projected contralaterally (Guillery 1979).¹² VEP studies have provided evidence of a similar pathway abnormality in human albinos (Jay and Carroll 1980).¹³ Guillery has stated that the

nystagmus and strabismus in albinos can reasonably be ascribed to this defect: it could also account for the asymmetry of OKN. It is tempting therefore to speculate whether a retinogeniculate pathway anomaly could be present in cases of early onset strabismus showing only temporal-nasal OKN. VEP studies have not as yet been carried out on patients in this study but Tsutsui and Fukai (1978)¹⁴ reported on three patients in whom they found evidence of a pathway defect. All had latent nystagmus and "alternating hyperphoria". They found supporting evidence from VEP in one patient. Inverse nystagmus was demonstrated in two out of their three cases but was not observed in our study.

Asymmetrical OKN has been found in both eyes of unilaterally deprived cats by van Hof-van Duin (1976, 1978).^{15,16} She suggested that lack of binocularly driven cells accounted for this finding. Our results do not support this view since symmetrical OKN has been seen in many patients lacking binocular vision.

Crone (1977)¹⁷ reported asymmetry of OKN in amblyopic adults but we have found that amblyopia is not the significant factor, both symmetrical and asymmetrical OKN have been seen in different patients with moderately severe amblyopia.

CONCLUSIONS

1. Only patients with the triad of early onset strabismus, nystagmus and DVD consistently demonstrated asymmetry of uniocular OKN.
2. Symmetry of OKN was the rule in patients with early onset strabismus uncomplicated by nystagmus or DVD.
3. No evidence was found to support the value of uniocular OKN testing as a means of assessing binocular vision but it is suggested that it has a place in the detection of nystagmus and DVD in early onset strabismus.

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NEW ASPECTS OF DISSOCIATED VERTICAL DEVIATION

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Abstract

Dissociated vertical deviation (DVD) is a condition where an eye deviates upwards upon reduction of illumination. The precise characteristics, differential diagnosis and aetiology of this condition however remain very confusing.

Forty-five patients with hyperdeviation under cover were divided into two groups:

(1) those with marked updrift

(2) those with small updrift

and reviewed with special reference to optokinetic nystagmus (OKN) and the visual evoked response (VER) in an effort to clarify thoughts on this condition.

Results indicate that a high percentage of patients with DVD show asymmetry of monocular OKN possibly indicating anomalies of visual fibre projection as evidenced by abnormalities on the VER. OKN may therefore be a useful and simple clinical test to assess the presence of DVD.

Key words: *Optokinetic nystagmus, visual evoked response, Bielschowsky phenomenon.*

INTRODUCTION

The phenomenon of either eye deviating upwards on occlusion was described as early as 1895 by Stevens.¹ Since then an amazing variety of terms have been used to describe this entity including: alternating hyperphoria, double hyperphoria, alternating hypertropia, occlusion hypertropia, anophoria, alternating sursumduction, dissociated vertical divergence and dissociated vertical deviation.

A great deal of the early analysis of this phenomenon was carried out by Bielschowsky² who used the term "dissociated vertical deviation", now usually abbreviated to DVD.

Most reports in the literature describe DVD as a slow rotation^{3,4} of the occluded eye progressively upwards to a moderate to marked degree,⁵ often associated with latent nystagmus and extorsion.³⁻¹³ Prolonged occlusion may be required to elicit the deviation.^{5,12,14} Past reports

have emphasised that this vertical deviation is not constant but rather, is very variable in nature.^{2-4,6,7,9,11,12,14-16} Although DVD may frequently be associated with an overaction of the inferior obliques or underaction of the superior obliques, these ocular muscle imbalances actually have no causal relationship with the DVD.^{2,4,5,11,12,16,17} Much confusion still remains however as to the precise characteristics which constitute this phenomenon.

In an effort to clarify our thoughts, it was decided to carry out an investigation of patients with DVD especially with respect to optokinetic nystagmus (OKN), following Mein¹³ who stated that these patients show asymmetrical responses on this test. A total of 45 patients were gathered who exhibited presence or increase of a hyperdeviation, either unilateral or bilateral, on dissociation. Some of these patients exhibited marked deviation under cover while in others this

deviation was only small. The patients were therefore divided into two groups:

Group 1 patients showed a significant updrift of an eye on dissociation.

Group 2 patients showed only a slight updrift.

Marlow¹⁸ in his investigation into the use of prolonged occlusion (24 hours to one week) as a diagnostic tool for heterophoria found, in the normal population, a high incidence of hyperdeviation of the covered eye. In view of this it was queried as to whether those patients in Group 2 actually showed DVD or only a latent vertical component after prolonged occlusion.

Therefore in order to determine if these two groups were actually demonstrating the same ocular condition, the characteristics of these patients were examined more closely with several features in mind:

Sex Distribution

This was of interest as it showed twice as many females as males (30: 15). Only two other reports on DVD were found in the literature with an analysis of sex distribution: Sprague *et al.*³ and MacLellan.⁵ This tendency for a preponderance of females was also found, to an even more marked degree, the proportions being 75% female: 25% male. This possibly suggests that DVD is a condition which is more likely to be found affecting females than males.

Type of Deviation

It is well documented that DVD most frequently occurs in the presence of a constant convergent deviation of congenital origin.^{3-5,8-13,16} Evidence from this series agrees with this statement: 31 of 45 patients having an esotropia, the majority of which had an onset of less than six months of age. It is of interest to note however, that in this series, eight patients showed only an intermittent deviation.

Visual Acuity

Bielschowsky² and Jones¹⁴ have stated that the anomalous vertical movements as found in DVD may also be seen in markedly amblyopic eyes. Visual acuity in this series did not appear to be

significant. Only two eyes showed marked amblyopia of less than 6/60, the majority of eyes having vision of 6/12 or better (74 of 94 eyes).

Binocular Vision

As previously stated, DVD is most commonly found in association with a constant squint, usually of longstanding, and consequently it is not surprising that most patients with DVD are found to have poor or no binocular function. This was the case in this series: no patient demonstrated good binocular single vision (BSV); fair BSV was found in only eight patients, the remaining 37 demonstrating a poor level or total absence.

Nystagmus

It is well documented that there is an association between DVD and nystagmus.^{5,7-9,13} In fact Anderson⁷ found that in his series of patients, every case of true latent nystagmus with one exception, showed a varying degree of "alternating hyperphoria". Mein⁹ has postulated that DVD may be a further manifestation of the Nystagmus Blockage Syndrome. Latent nystagmus was present in only 53% of cases in this series however, if nystagmus is fine it may only be demonstrated on visuscopy and not all patients in this series had this test performed.

Ocular Movements

Mein^{9,13} in her series of patients with DVD has found a high incidence of A pattern. This phenomenon has also been described in other reports.^{4,16,17} MacLellan⁵ however, found that the incidence of A, V, or X pattern in her series was about equally distributed. In this present series overall, there was a slight preponderance of V pattern (17V: 11A). If the two groups are examined separately, this preponderance of V pattern is found to be more marked in Group 2 (Group 1 — 10V: 7A; Group 2 — 7V: 4A).

Bielschowsky Phenomenon

This phenomenon, first described by Bielschowsky,² states that when the illumination of the fixing eye is sufficiently reduced, the upward deviated eye under cover will show an

isolated downward movement which will bring it down to or even below the midline as the fixing eye remains in the primary position. The Bielschowsky phenomenon may be used as a diagnostic test to differentiate between a true DVD and a basic hyperphoria, the phenomenon not being demonstrated in the latter.

It has been stated however, that this phenomenon can only be demonstrated in about 50% of those patients with DVD.¹¹ As such it would not seem a reliable test to use for differential diagnosis.

It is interesting to compare the results of this test as found in Group 1 and 2 of this series. Of the eyes suspected of having a DVD and that were tested for the Bielschowsky phenomenon, in Group 1 69% (11 of 16 eyes) showed a positive response, whereas in Group 2 54% (6 of 11 eyes) showed a positive response.

Optokinetic Nystagmus (OKN)

Researchers¹⁹⁻²¹ have noted asymmetry of monocular OKN in animals and humans where there is a lack of binocularity, for example, in congenital esotropia. This asymmetry is found when, with movement of stripes in a temporal to nasal direction, a normal OKN response is elicited however, with stripe movement in a nasal to temporal direction the response is either very erratic or totally absent.

Mein¹³ in her investigation of monocular OKN in congenital esotropia found that only those patients with DVD showed an asymmetrical response. She therefore suggested that OKN might be a useful diagnostic tool in the detection of DVD in early onset strabismus.

With this in mind, the patients in this series were examined to determine if the two groups could be differentiated. Of those eyes suspected of having DVD that were tested for OKN responses, in Group 1 97% (37 of 38 eyes) showed asymmetry with poor nasal to temporal response whereas in Group 2 91% (10 of 11 eyes) showed this asymmetry.

Visual Evoked Response

Mein¹³ and Fitzgerald²² have suggested that this asymmetry of monocular OKN may occur as a

result of an abnormality in the pathway of visual fibres where some of the fibres from the temporal retina actually decussate at the chiasm and are therefore represented in the contralateral visual cortex. This may be detected by the use of the visual evoked response (VER).

Of the eyes in this series suspected of having DVD that were tested for their VER, in Group 1 81% (22 of 27 eyes) showed abnormal VER indicating anomalous projection of the temporal retinal fibres whereas in Group 2 83% (five of six eyes) showed this abnormality.

DISCUSSION

The testing of the Bielschowsky phenomenon, OKN and VER was found to be of particular interest in these patients as these are put forward as differential diagnostic tests to distinguish between true DVD and a basic hyperphoria such as may be found in a primary overaction of the inferior oblique muscle.

The Bielschowsky phenomenon is known to be an inconclusive test even in the presence of true DVD. Responses to this test in this series could indicate that those patients in Group 2 are less likely to be true DVD. Conversely, it may only indicate that a positive response is more likely to occur in the presence of the more marked cases of updrift and therefore its value as a differential diagnostic test could still be questioned.

Testing for abnormalities of responses with OKN and/or VER would appear to be a much more reliable indicator as to the presence or absence of true DVD.

Clearly there has been confusion in the past as to the precise characteristics which constitute DVD. No doubt it is this confusion that has led to the plethora of terms that have arisen.

The confusion over this phenomenon has also led to the great variety of attributed aetiological factors. Although previously cited as an aetiological factor,^{10,23} simple underaction of the superior obliques and corresponding overaction of the inferior obliques is now well accepted as not being the cause of DVD.^{2,4,5,11,12,16,17} In fact, it has been documented that DVD may occur in the presence of overaction of the depressor

muscles, for example, the superior obliques.^{12,16,17}

It is well known for there to be a disturbance of binocularity in patients with DVD but, which of these two comes first? Verhoeff¹⁰ suggested that there may be arrested development or abnormality of the monocular conjugate mechanism of eye control such that certain movements of each eye then become independent. Posner²⁴ suggested that with weak binocular linkage there is apparent dissociation between the two eyes. This then gives rise to an aberration of the tonus-regulating mechanism of the eye muscles such that the eye favours the position of rest — elevation. Bielschowsky² suggested that these anomalous eye movements are caused by intermittent excitations of the "subcortical vertical divergence centres" and may become manifest when there is a lack of homogeneous retinal stimulation, for example, when there is reduction of the illumination to one eye. It is currently accepted that the aetiology is an innervational cause of supranuclear origin.⁴

This series suggests that these patients have some abnormality of visual fibre projection to the higher centres of eye movement control. This may then predispose these patients to squint, particularly of congenital origin, and also to the ensuing phenomenon of DVD.

CONCLUSION

In conclusion, it would appear after overall assessment that the majority of patients in both Group 1 and Group 2 do have a true DVD but to differing degrees.

The testing of optokinetic nystagmus and the visual evoked response are put forward as being useful diagnostic procedures in the differentiation of patients with this entity and maybe also as a method of predicting which of those patients with congenital esotropia will, at a later time, go on to develop this phenomenon of dissociated vertical deviation.

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EVIDENCE OF ABNORMAL OPTIC NERVE FIBRE PROJECTIONS IN PATIENTS WITH DISSOCIATED VERTICAL DEVIATION (DVD) — A PRELIMINARY REPORT*

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Abstract

Abnormal optic nerve pathways can be demonstrated by testing half field checkerboard VER's. This method has been used to detect abnormal optic nerve fibre projections in human albinos, a group who also have anomalous nystagmoid movements.

Patients with DVD have recently been observed to have abnormal nasotemporal OKN (Mein 1982). The hypothesis that these patients also have abnormal visual pathway projections was tested.

Patients with DVD (both unilateral and alternating), congenital esotropes without DVD and normal subjects were investigated. Results showed a very high incidence of abnormal VER recordings in patients with DVD while recordings from congenital esotropes and the control group were normal. As well as demonstrating abnormal optic nerve fibre pathway projections, the VER's showed a large increase in latency in all patients with DVD which was not present in the other two groups studied. These results occurred regardless of visual acuity or amblyopia in the eyes tested.

The high correlation between VER abnormalities and naso-temporal OKN anomalies indicates the importance of the latter in diagnosing DVD.

The possible significance of abnormal pathways in the presence of a DVD is discussed.

Key words: VER, albinos, abnormal projection, OKN.

Dissociated vertical deviation (DVD) was first described by Stevens in 1896. Bielschowsky (1932) was the first to give detailed observations of this disturbance.

Recently Mein and Johnson¹ have summarised the principal characteristics as:

1. Elevation of either eye when the amount of light entering the eye is reduced by occlusion or other means.
2. Extorsion as the eye elevates.
3. Latent nystagmus.

The aim of this paper is to show that patients with DVD have abnormal optic nerve fibre pathway projections. This was confirmed using visually evoked responses (VER's).

The importance of this finding to orthoptists is that patients with this abnormality also have

abnormal opto-kinetic nystagmus (OKN), the latter being an easily demonstrated clinical manifestation of the abnormality in retinal projections.

The VER is primarily used in the diagnosis of conditions affecting the optic nerve and its pathways. Half field VER's may be used to determine the relative contributions of optic nerve projections to the visual cortex. Neither nystagmus nor amblyopia affect the accuracy of recording these projections.

When stimulating temporal retinal fibres in the right eye the normal response (i.e. the response similar to that recorded at the central occipital electrode) is recorded from the right visual cortex (see Fig. 1). As there is virtually no input going to the left visual cortex the response from this

* This paper was awarded The Emmie Russell Prize for 1982.

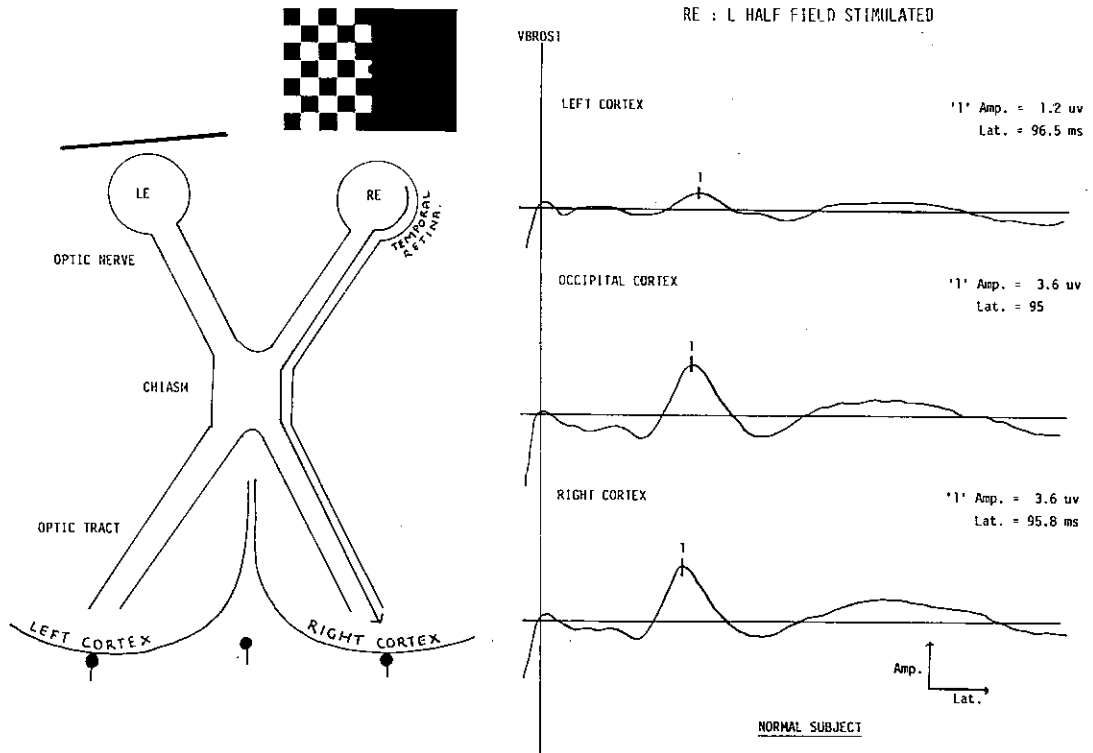


Figure 1: VER tracings recorded from temporal retinal stimulation in the right eye.

electrode should be very reduced. This is also clearly demonstrated in Fig. 1.

This method has been used to study the abnormal decussation of temporal retinal fibres² that has been found in 70% of human albinos.³ Thus, any marked abnormality in VER's recorded from patients with DVD would suggest an anomaly of decussation of optic nerve fibre pathways.

In normal subjects OKN is a jerk nystagmus with a slow phase in the direction of drum rotation and the fast phase in the opposite direction.

This paper reports on the VER and OKN findings of 20 patients with DVD, 13 normal subjects and six congenital esotropes ranging in age from four to 47 years.

METHOD

Three groups of patients were examined:

Group 1 consisted of 13 normal subjects. Each of these patients were ophthalmologically normal

with corrected visual acuity of 6/6 or better. Only the right eye was tested.

Group 2 consisted of 20 DVD patients. Eight had unilateral DVD and 12 had alternating DVD.

Group 3 consisted of six patients with congenital esotropia (i.e. a positive history of strabismus before six months of age). None of these patients had any demonstrable DVD.

All patients were given a full orthoptic examination independently by two orthoptists.

VER's were tested monocularly using a 16° half field check screen. The subjects were instructed to fix on the central spot all the time to ensure only hemi-retinal stimulation. Thus, when the right half of the screen is visible (when testing the right eye) only nasal retinal fibres receive stimulation (see Fig. 2A).

Three active electrodes were used to detect optic nerve projections. The occipital electrode (see Fig. 2A) mainly detects responses from the macular area. In hemi-retinal stimulation this

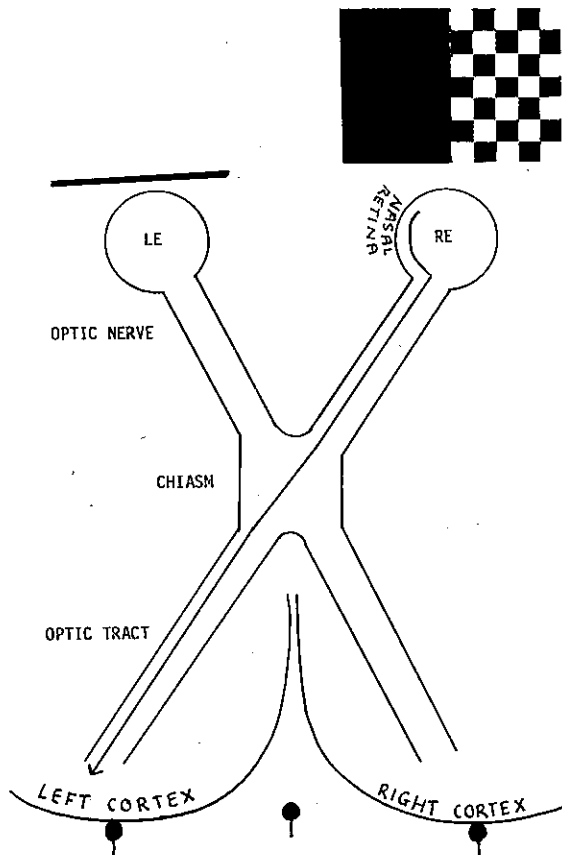


Figure 2A: Hemi-retinal checkerboard stimulation.

response is normal. The two other electrodes were placed 5 cms laterally on either side of the occipital electrode. Recordings were taken individually from lateral electrodes thus detecting both nasal and temporal halves of the retina. The reference electrode was placed on the forehead and an earth electrode was placed on the ear.

OKN was assessed monocularly using the opto-kinetic drum at 1/3 m. Assessments were made rotating the drum both naso-temporally and temporo-nasally (see Fig. 2B).

RESULTS

Group 1: Normal Subjects

Normal subjects showed the characteristic VER recordings expected from hemi-retinal stimulation (see Fig. 3). When stimulating nasal retinal fibres in the right eye the normal response (which

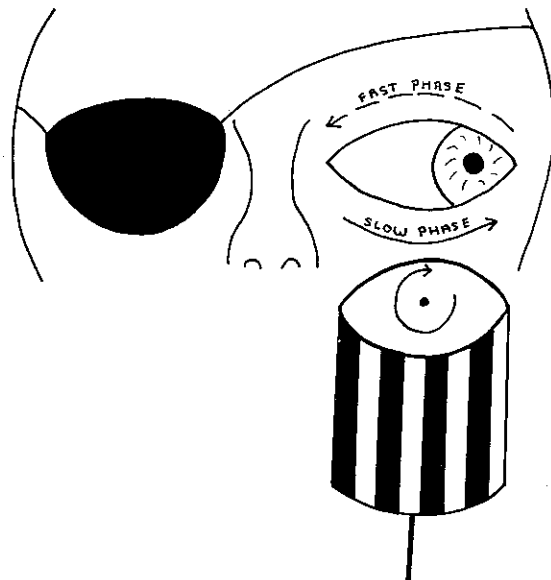


Figure 2B: Unilateral naso-temporal OKN.

was similar to the response recorded at the occipital electrode) was recorded from the left visual cortex (see Fig. 3). As there was virtually no input to the right visual cortex, the response recorded from this cortex was very reduced. This was clearly demonstrated in the VER tracing.

The latency of point "I", or the time taken for the impulse to travel from the retina to the visual cortex in all these patients was normal (approx. 96 ms). Amplitude recorded from the occipital electrode (3.6 uv) and the stimulated hemi-retina (3.6 uv) was also normal.

No abnormality in OKN was detected with naso-temporal or temporo-nasal drum rotation in normal subjects.

Group 2: DVD Patients

Seventy-nine per cent of the patients in the DVD group showed abnormalities in the VER tracings recorded from temporal retinal optic nerve fibres. In Fig. 4, recordings taken from temporal retinal stimulation of the right eye show that the normal response (i.e. the response most similar to the recording from the occipital electrode) was recorded from the left visual cortex. However, with temporal retinal stimulation (RE) there should be virtually no input to the left visual

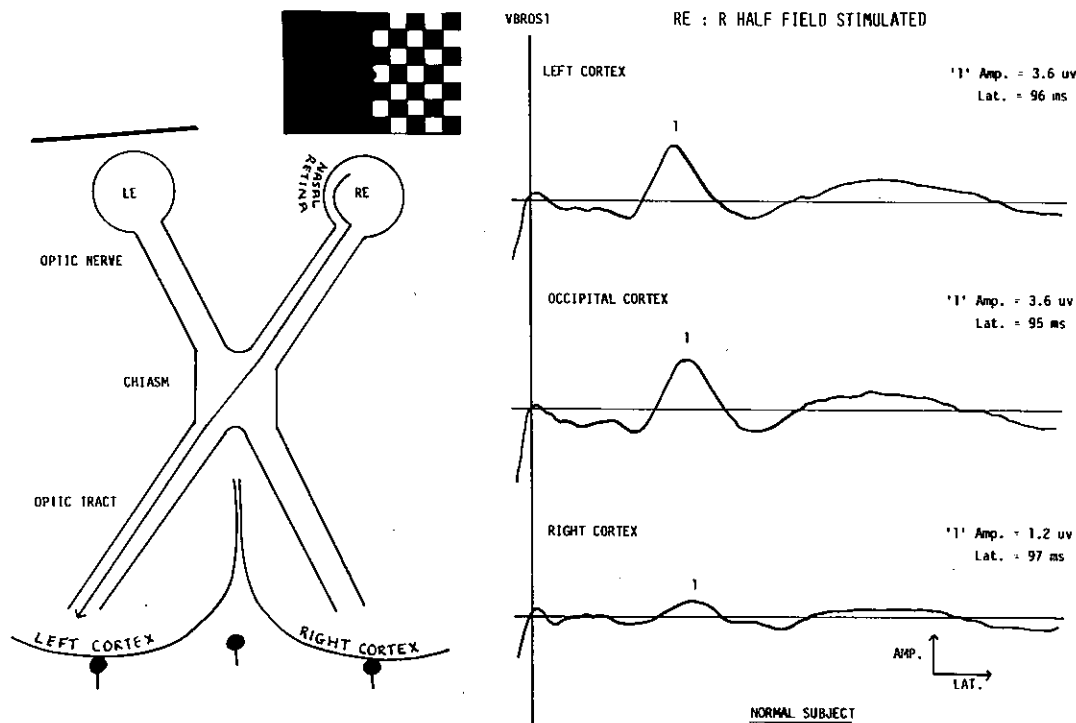


Figure 3: VER tracing from normal subject (nasal retinal stimulation).

cortex. Conversely, the right cortex should be receiving a normal input but the response recorded was greatly reduced.

Abnormal responses were recorded from nasal retinal stimulation in 37% of the patients with DVD.

In the patients with unilateral DVD temporal retinal stimulation of the eye without the DVD was abnormal in only 25% of the cases.

The latency of the point "1" was increased in all patients with DVD. This increase was most marked in the tracing from the abnormal temporal retinal fibres.

OKN was abnormal when the drum was rotated naso-temporally in 82% of the DVD patients while temporo-nasal rotation of the drum produced OKN anomalies in 12%.

Group 3: Congenital Esotropes

Eight per cent of the congenital esotropes in the study showed abnormal temporal or nasal retinal optic nerve fibre projection. There was a slight increase in latency of point "1" in all these patients.

OKN was normal in all but one eye of one patient.

DISCUSSION

The abnormal VER's recorded in patients with DVD constitute evidence of abnormal decussation of temporal retinal fibres at the chiasm. This is so because (as is seen in Fig. 5) the most normal response was recorded from the left cortex when only temporal retinal fibres were stimulated in the right eye, so some of the stimulated temporal fibres may cross over at the chiasm and go to the left cortex. Also, the decreased response at the right visual cortex is indicative of a decreased input to this area which can only be explained by misdirection of the fibres.

Several different studies conducted on human albinos have shown that optic nerve fibres originating in the temporal retina actually decussate at the chiasm in 70% of cases.³ This abnormal decussation produces characteristic anomalies in VER's similar to those found in 79% of the DVD eyes in this study. No sig-

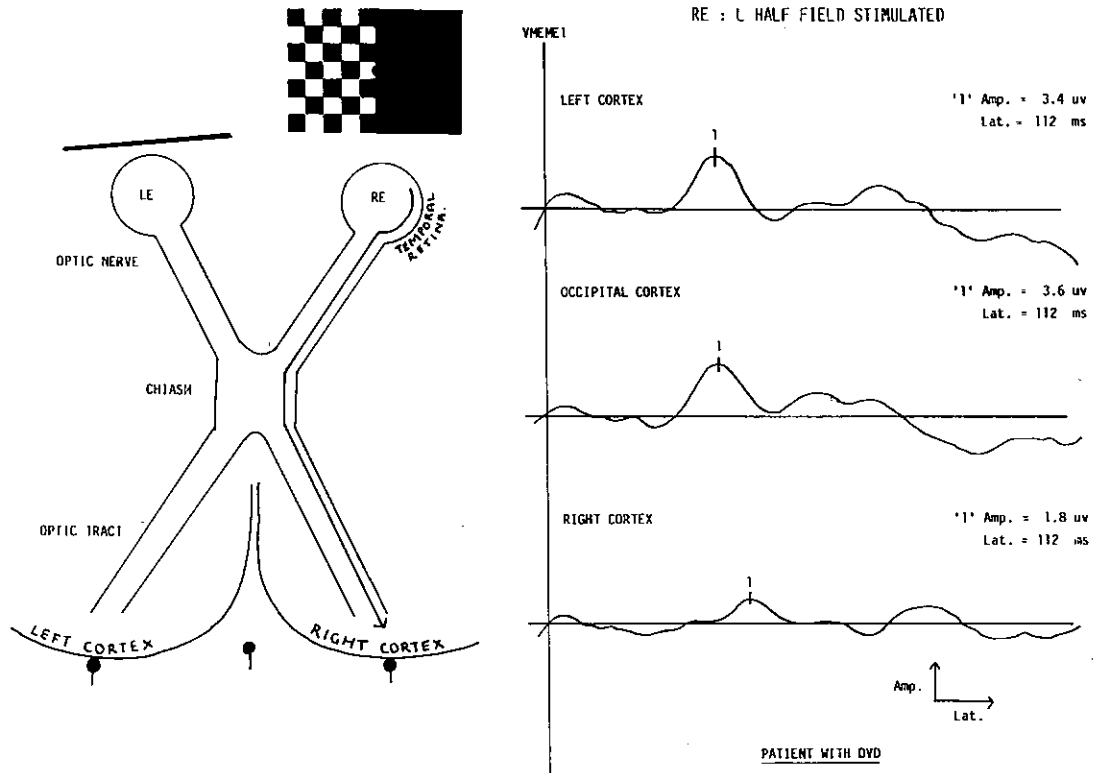


Figure 4: DVD patient: right eye temporal retinal stimulation.

nificant abnormality in nasal retinal projection pathways in albinos have been reported in the literature, however, in this study 37% of the DVD patients also show anomalies in the nasal retinal fibre projection.

In the unilateral DVD sub group 75% of the patients had normal VER tracings in the *non* DVD eye and anomalous recordings in the DVD eye, indicating that DVD does indeed occur unilaterally in some cases. The other 25% of the subgroup demonstrated temporal retinal fibre projection anomalies in both eyes. Thus, they

may have a bilateral DVD which is more marked in one eye.

Latency, or the time taken for the response to reach the visual cortex was markedly increased in patients with DVD. The misdirection of the optic nerve fibres at the chiasm could cause interference to the normal conduction along the nerve thus it takes longer for the response to reach the cortex.

Ninety-two per cent of the congenital esotropes in the study showed no abnormalities in VER's. This finding is in keeping with a study

TABLE 1: Summary of Results

Patient group	Abnormal VER tracings with		Abnormal OKN (N→T drum rotation)
	Temporal retina fibre stimulation	Nasal retina fibre stimulation	
Normals	0	0	0
Congenital esotropes	8%	8%	8%
DVD	79%	37%	82%

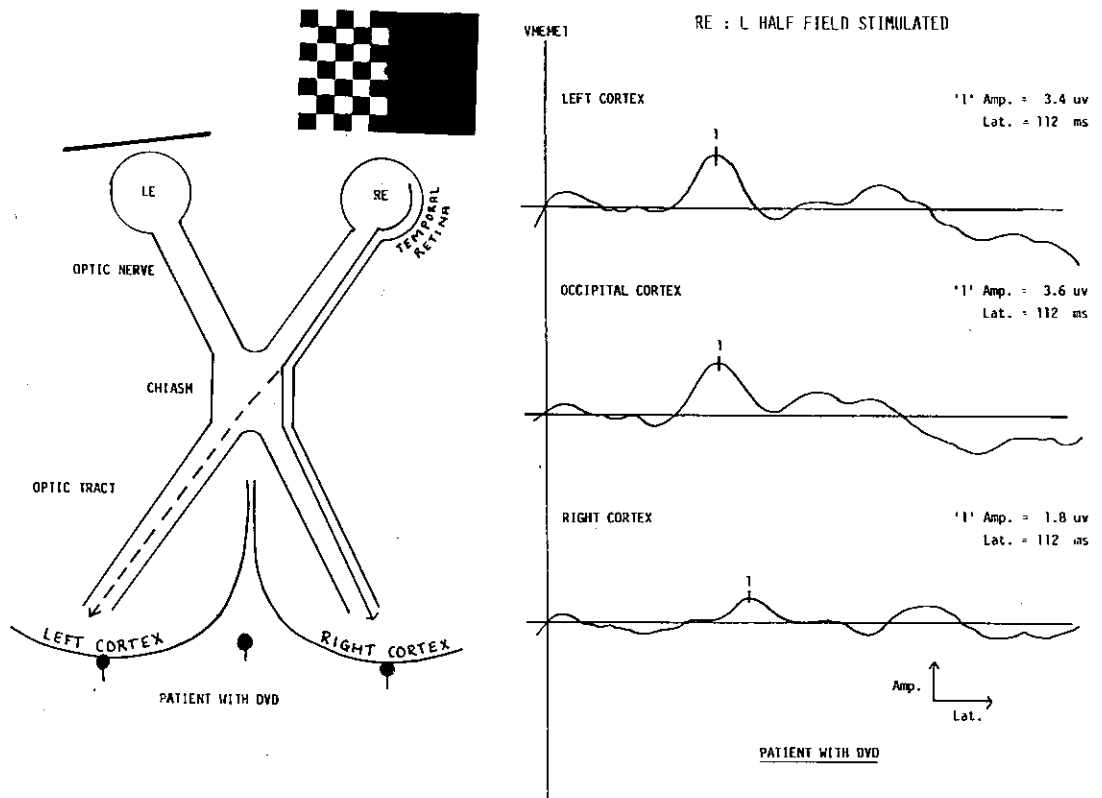


Figure 5: Abnormal decussation of temporal retinal fibres in a patient with DVD (re temporal fibres stimulated).

by McCormack⁴ who studied normally pigmented squinters (without DVD) and concluded that they had no visual pathway anomaly. The one patient that had abnormal VER's in this group may go on to develop a DVD at a later age.

The abnormal OKN which occurred in 82% of the DVD patients in this study is a significant finding. These results support those in a study of Mein⁵ who reported that all patients with DVD had abnormal OKN with naso-temporal drum rotation whereas congenital esotropes who did not have DVD (and were "too old to develop DVD") had normal OKN. Thus OKN is shown to be a useful clinical test in the diagnosis of DVD.

In order to have normal BSV there must be normal input from corresponding retinal layers to the lateral geniculate nucleus (LGN). Only

three out of the 20 DVD patients in the study had any demonstrable BV and none had BSV. The abnormal fibre projections in DVD patients would disrupt the ordered structure of the LGN hence these patients would not have BSV.

CONCLUSIONS

This study demonstrates evidence of anomalous crossing of temporal retinal fibres in patients with DVD together with evidence of some anomalous projection of nasal retinal fibres.

The results have demonstrated that misdirection of optic nerve fibres may vary between the two eyes and that in apparently unilateral cases of DVD the VER may be abnormal in only one eye, supporting the premise that DVD is not necessarily a bilateral condition.

There is a high correlation between anomalous naso-temporal OKN and abnormalities in VER

recordings. The VER recordings have shown that abnormal retinal projections occur in these patients. Therefore, an abnormal naso-temporal OKN response in the absence of a demonstrable DVD may anticipate the later development of this defect.

ACKNOWLEDGEMENTS

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OCULAR MOTILITY DISORDERS FOLLOWING HEAD INJURY

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Abstract

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

INTRODUCTION

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

Borowski and Matkus,² Roper-Hall,³ and Holmes⁴ all deal with blindness induced by closed head trauma.

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

Sen⁶ reports on paradoxical eye movements for two cases, one acquired following head injuries. This case presented with a ptosis and an absence of elevation. Hartje *et al.*⁷ stress the value of ocular movements in screening for organic cerebral dysfunction; they do not maintain the value in trauma induced dysfunction. Nystagmus was found to be the most common symptom following head injury in a sample of 100 subjects described by Meran *et al.*⁸ Miretskaia⁹ discusses the state of tonic convergence in closed brain injury for one subject.

Van Zomeren and Deelman¹⁰ examined long-term recovery of visual reaction time after closed head injury. A large sample (n=57) was employed and reaction time discriminated between subgroups formed on the basis of length of unconsciousness after injury.

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

Cowey and Porter¹² working with monkeys demonstrated a loss in global stereopsis following brain damage. They suggest that this ability may be selectively impaired following brain damage in man.

Stanworth¹³ presents a series of eleven patients chosen specifically for their complete loss of fusion following head injury. In this series all patients presented with diplopia and loss of fusion. One patient had received his head injury as a result of a motor cycle accident, six had been in motor vehicle accidents, one a mining accident, and another a blow to the head. The cause of injury in the other two patients is not given.

Field loss was reported in only one of Stanworth's¹³ series. Two patients presented with nystagmus, one with a convergence weakness and eight were reported to have heterotropias. Of these eight deviations two were known to have existed prior to the head injury. Two patients ultimately developed multiple sclerosis and it is suggested that "head trauma may precipitate the ocular signs of disseminated sclerosis" (Stanworth, 1974, p. 270).¹³

Waddy¹⁴ analyzed the injuries to 32 eyes of 30 children who survived motor vehicle accidents (MVA's). She found that each child was unrestrained and that the resulting "eye injuries are disastrous". (Waddy 1981, p. 119).¹⁴

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

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

METHOD

A checklist was designed which enabled data to be gathered on the following variables; age, sex, pre-existing medical history relevant to ocular disturbance (e.g. diabetes), cause of head injury, duration, communication ability, previous ocular history, major ocular symptoms (if any), presence or absence of a ptosis, presence and

type of nystagmus, presence and type of abnormal head posture (i.e. ocular or non-ocular), pupillary responses, visual acuity right and left, near and distant, presence and type of strabismus, convergence, saccades, colour vision, stereopsis, accommodation, ocular movements and visual fields.

The population examined in this study consisted of all patients in or admitted to a head injury ward in a large metropolitan hospital over the period January to September 1982. To obtain more recent comparative data than that given by Stanworth¹³ a retrospective search of all patients from this ward, referred to the Eye Clinic in this hospital, for the period 1975 to December 1981, was undertaken. Patients resident in the ward in January 1982 were included in the population and not in the retrospective group.

TABLE I
Sex and Age of Sample

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

RESULTS AND DISCUSSION

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

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

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

TABLE 2
Cause of Head Trauma

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

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

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

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

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

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

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

TABLE 4
Major Ocular Symptom

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

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

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

TABLE 5
Pupillary Responses

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

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

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

It was possible to do a VA on all patients in the TP, 19 of the group used Snellen's linear charts, one Snellen's single letters and another Sheridan Gardiner single letters. Only three showed an abnormal reading technique, all three

TABLE 6
Visual Acuity Six Metres

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

being field losses. Distance (6 m) VA ranged from 6/5, to hand movements in right eyes and 6/5 to blind in left eyes. Visual acuity for 6 metres in this group is given below.

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

TABLE 7
Visual Acuity 33 cm

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

completed. On the second occasion the patient had been discharged.

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

An assessment of the presence/absence of strabismus was undertaken using the cover test

at 33 cm and 6 m and an accommodative target, in the case of the TP.

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

TABLE 8
Strabismus

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

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

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

TABLE 9
Nerve Palsies

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

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

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

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

Saccades were observed and saccadic velocities estimated in all patients in the TP. Ten of the group had abnormal saccades, of whom three had abnormal horizontal movements, two had abnormal vertical movements and five had

TABLE 10
Convergence Near-point (RAF) in Centimetres

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

abnormality of both horizontal and vertical movements. Of these 10 all but one had a manifest strabismus and of these six were nerve palsies. Thus, of the nine identified nerve palsies in this group six had defects of saccadic movements. In addition the patient with the mechanical restriction, as would be expected, also had defective saccades.

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

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

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

All patients in TP had BSV assessed using the TNO random dot stereo test. It was not possible

to elicit any response from eight patients (one of whom was unocular). Two of these patients were aphasic and were unable to give a meaningful response to the test and of the other five two were amblyopic and three had very large constant squints. It was not determined if these three could achieve the test with prisms neutralising their deviation.

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

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

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

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

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

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

CONCLUSION

While proving impossible to compare the two groups on all variables defined at the outset, it has been possible to make comparisons on the principal variables of symptoms, visual acuity,

strabismus, nerve palsies, and convergence near point.

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

As Mein¹⁵ points out "The role of the orthoptist in the care of patients with head injury is firstly diagnostic, ... and secondly therapeutic". It would prove interesting to examine the effect on rehabilitation of early orthoptic and ophthalmological intervention in a series of head injured patients.

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THE ORTHOPTIST AS A SAFETY NET*

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Abstract

The Krongold Centre at Monash University is a clinical research and educational laboratory. It supports approximately 150 children per week in their local settings. The children have one or more handicaps to learning.

The orthoptist's areas of involvement in the Centre's programmes are:

- orthoptic screening
- orthoptic treatment on referral by an ophthalmologist
- assisting staff in tuition using a low vision aid to teach visual perception
- being part of a multi-disciplinary team assisting with visual training in multi-handicapped children.

Cases in which eye problems are present, but no eye treatment is indicated, raise the following questions: the degree of handicap to learning posed by the eye problems; ways of off-setting these handicaps; why academic success can, in fact, be achieved despite the presenting problems.

Key words: Krongold Centre, handicaps to learning, education laboratory, orthoptic screening, visual training.

ORTHOPTICS AT THE KRONGOLD CENTRE

The Krongold Centre

The Krongold Centre at Monash University is a clinical research and educational laboratory which has evolved from the personal practice of the Founding Director, Professor Marie D. Neale. The Centre was established by a gift from the Krongold family, which was matched by a grant from the Department of Social Security under the Handicapped Persons Act. Through the experimental work, services are given directly to the community, supporting children in their local community settings whether these be pre-school, developmental centres, special centres, or the regular school.

Those who are served by the Centre are:

- Infants, groups of children and young adults with specific severe physical or intellectual handicapping conditions,
- children with learning dysfunctions from regular schools,

—handicapped young persons in special centres,

—very able or specially gifted children.¹

Admittance to the Centre is on the basis of need and the service is offered free of charge. Operational funds come from a number of sources, including donations and bequests, the Department of Social Security, Monash University itself and teachers from the Victorian Education Department.

Architecturally the concept of the Centre is to provide a functional flow of diagnostic and treatment services from the moment that a child and parent are seen. Eight diagnostic teaching rooms form the central core of the building and the rooms have been based on a Piagetian view of intelligence from the presymbolic stage for playing shop or house, through to formal operations and abstract thinking skills. As soon as a child can imitate and play and imagine, he moves into, for example, the kitchen where he joins with other children making gingerbread

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Reprint requests to: Krongold Centre for Exceptional Children, Monash University, Clayton, Victoria, 3168.

men and attractive little dishes from natural ingredients.

The third room is fitted out with all the materials for measurement and quantification in maths programs, although practical maths will be reinforced by teachers in other parts of the building, for example, the kitchen, gymnasium, swimming pool and art room.

The fourth room is designed as a visual-literacy station with a wide array of reading teaching schemes. This is also where the orthoptist undertakes assessments and works with the teachers.

Another room acts as an assembly point for the children to which they come with their parents. The music specialist, with other teachers, engages them socially through themes using music and movement, teaching children a repertoire of nursery rhymes and songs.

Adjacent to the circular building is a small gymnasium for physiotherapy and teaching the basic sports skills. A heated swimming pool is separated from the gymnasium by toilet rooms which serve both areas. Its particular features of ramp and teaching trench facilitate working with those who are disabled or fearful of the water.

What is offered at the Centre is perhaps exemplified by Noel's program. Noel is a 10 year old with multiple handicaps. At five years of age he was referred to Professor Neale and according to normal testing criteria he had:

- below average intellectual functioning,
- very poor adaptive behaviour,
- visuo motor disabilities.

Under normal circumstances he would not have been able to cope with regular school. However, with Centre support in two sessions totalling five hours per week, Noel has been maintained in regular school right through to Grade III. The multidisciplinary team has taught him sequentially, motor skills, visual-language skills, literary maths skills and independent living skills.

This year (1982) there are approximately 150 children and young adults attending the Centre on a sessional basis. The two points to note are:

- the objectives of both individual therapy and group interaction are attempted within

a very modest part-time attendance by the children averaging three hours per week, —the staff to pupil ratio, calculated on the basis of the hours per week of each group is roughly one-to-one by careful placing of teams of part-time personnel with the full time staff. This reflects the intensive nature of the tuition and therapy and also the considerable time needed for assessment and liaison with parents and schools must be eliminated from this ratio.

THE ORTHOPTIST'S ROLE

Part of the theoretical position adopted in the programming is that, because the visual input is a significant factor in the learning process, the eyes should present to the brain the clearest possible image in the most physically comfortable manner. Thus the role of the orthoptist is frankly experimental.

As the orthoptist I have three areas of involvement in the Centre's programs:

- (a) orthoptic screening of all children in the programs, and research control groups,
- (b) giving orthoptic treatment to overcome defects in binocular vision, on referral by an ophthalmologist,
- (c) assisting staff conduct academic programs. In particular I use a Low Vision Aid to encourage visual perception.

The purpose of orthoptic screening is to discover anything about the vision that could hinder learning, so that appropriate treatment can be arranged. It is also used to ensure, as far as possible, that there are no significant differences in visual function between groups involved in research projects and their related control groups.

The tests I give at the Centre are routine ones—acuity, cover test, convergence, eye movements, fields, dominance, and colour vision. Approximately 120 children are screened per year. Ages range between three and 12. Some 30 are pre-schoolers and the other 90 are attending primary school. As would be expected there are very few previously undetected problems in the older (say 7+) children. However, I find it necessary to refer about 12

per year of the younger ones to the Royal Victorian Eye and Ear Hospital. Most of them have low vision due to refractive error. Between one and three children per year are re-referred for orthoptic treatment.

As a general rule, any major eye problems have been detected before I screen the children at the Centre. However, occasionally some serious condition has been overlooked by the referring agency and the orthoptic screening reveals the need for a full ophthalmic examination.

CASE HISTORY —

The Orthoptist as Part of a Multidisciplinary Team

Jessie is a multi-handicapped low functioning three year old, with a history of developmental delay. She has no speech, and while capable of sitting and standing, she cannot walk. Our assessments suggested that contact through all her available senses is necessary to draw her into an active participation in the activities of a three year old's world. Our endeavours are directed to this aim in an early intervention program. For example, the physiotherapist creates body awareness in the pool through feel of water on the child's skin and through teaching her to blow bubbles and to splash. Buoyancy in the water helps her to obtain an easy upright stance, and the kicking strengthens her limbs.

How does the orthoptist work in such a case?

One of the diagnostic observations of Jessie is that visual attention is virtually non-existent. She does not look at things. Her gaze wanders around, fleetingly focusing on objects. Even when she intends to follow an instruction she does not use her eyes to assist performance. If effective learning is to take place Jessie must learn to observe salient details and relationships. I am, therefore, helping her by teaching her the first step, which is visually directed reaching.

It involves repetitive guidance of the child in an enjoyable activity that co-ordinates both eyes and hands. With Jessie sitting on the mother's lap, I place a Cheezel on each of the fingers of one hand which is held in front of her eyes. Then we bring the hand slowly up to the face to let

her taste the Cheezel. She is then encouraged to take the Cheezels off her fingers with the other hand. All the time we are encouraging her to watch these actions. After some weeks of many such activities, reinforced by her mother at home, we are beginning to see Jessie use her vision in the group activities in music and movement where similar attending behaviour is directed through attractive materials and toys.

CASE HISTORY

—the Unanswered Question

Bryan is now 10 years old, and is part of Professor Neale's longitudinal research group. A traumatic birth appears implicated in mild cerebral palsy and impoverished social development. Through systematic therapy and teaching we can say that he is beginning to make substantial and sustained academic progress, enough to keep him within a regular school. The orthoptic assessment showed constant right divergent squint with latent nystagmus, binocular visual acuity 6/9. As he is cosmetically acceptable no treatment is indicated at this stage.

The unanswered questions are:

- (a) How much of an extra handicap to learning is his eye condition?
- (b) Why does a visually orientated program or reading bring such great success to a child with visual problems such as these?
- (c) How can we program him visually to offset the distorted visuo-motor inputs which must occur from cerebral palsy?

These are just some of the many questions that challenge us in our experimental programs in the Centre. They also contribute to the excitement of helping young people gain autonomy and success in their schools.

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In conclusion, I thank Professor Neale for the opportunity to take part in the Centre's activities and for her support and advice in preparing this paper.

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INTRACTABLE DIPLOPIA

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Abstract

Four patients presented with apparent spontaneous diplopia. The diplopia was diagnosed subsequently as "intractable". These cases are discussed with special reference to the possible aetiology of "intractable" diplopia.

INTRODUCTION

Diplopia is a disturbing symptom which can be caused by a paresis of one or more of the ocular motor nerves, by mechanical restrictions or by decompensation of a heterophoria. Treatment of diplopia involves investigation of the possible cause, as diplopia can be the presenting sign of an underlying serious condition, and correction by means of surgery, prisms, orthoptic exercises or a combination of these treatment forms. Occasionally patients have diplopia which is unable to be eliminated. Four such patients presented with apparent spontaneous diplopia which was diagnosed subsequently as "intractable".

METHOD

All patients (three female, one male) had routine ophthalmological and orthoptic examinations.

Detailed ophthalmological and orthoptic histories were available for each patient.

RESULTS

The common characteristics of these patients were:

1. The onset of diplopia in the teenage years was apparently spontaneous and intractable.
2. In each case there was a history of early onset of convergent strabismus. Initially, two patients presented with constant convergent strabismus and two with intermittent convergent strabismus which later decompensated and became constant.
3. None of the patients had a history of dense amblyopia. Two had equal vision and two had a small degree of amblyopia — 6/12, 6/6 the other 6/4, 6/9.

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4. None had demonstrable fusion at the time that the diplopia became troublesome. Careful examination of the medical histories revealed that fusion had never been elicited in the cases of constant strabismus. In the two cases which presented as intermittent strabismus, their fusion ability had been unstable at best and now could not be demonstrated.
5. At the onset of the diplopia none of the patients had a demonstrable suppression scotoma. It cannot be deduced from the histories whether a suppression scotoma was ever present or whether the ability to suppress had been lost, in the cases of constant strabismus. However the lack of suppression can be explained in the two cases of intermittent strabismus as they had undergone active suppression treatment to improve their fusional control.

DISCUSSION

The characteristics of this group suggest that the intractable diplopia was the result of a lack of or a loss of the ability to suppress.

What then is the mechanism of suppression? Burian and von Noorden¹ considered that suppression, and by extension amblyopia, represented a loss of the rhythm of binocular rivalry; Fells² asks "can facultative suppression become obligatory and is this the neurological basis of functional amblyopia? Ikeda,³ on the other hand suggests that amblyopia and suppression are different entities. She has found that amblyopia is caused by poor foveal stimulation, but admits that the physiological basis of suppression is still unknown. The authors wish to stress that it is unwise to apply results of animal experiments to human conditions, but Ikeda's hypothesis that there is a different physiological basis for amblyopia and suppression is an attractive one.

This study was unable to offer any further explanation as to the mechanism of suppression. However, comment can be made on the spontaneity of the diplopia. Contrary to expectations diplopia had been noted in all cases

at an early age but had become symptom producing in the teenage years. This can be explained in the two cases who had active suppression treatment as children. In retrospect this treatment probably contributed to the intractable diplopia. As these patients had no demonstrable fusion and no amblyopia, suppression was the only mechanism by which diplopia had been avoided.

In the other cases no reason could be found to account for the absence of suppression. Kilmister and Smith⁴ suggested that trauma could disturb a patient's "central cortical suppression" mechanism but none of these patients had a history of trauma, nor of emotional stress, illness, change in glasses or a change in the angle of strabismus. This may suggest, and the authors would agree with Hugonnier,⁵ Burian and von Noorden¹ and Duke-Elder,⁶ that the onset of symptoms could be related to the patients' personality type rather than to any change in the ocular status.

The personality of the patients may also explain why the various methods of treatment have been unsuccessful. Various forms of occlusion, including opaque contact lenses, have been tried but all patients complained that their field of vision was reduced. The most successful form of treatment has been to encourage the patients to try to ignore the diplopia and to stress that the diplopia is not a sign of a more sinister problem. While helpful, this method is far from satisfactory. Hypnosis (Canadian Orthoptic Meeting 1982) has been suggested as an alternative form of treatment and may be beneficial for this small but distressed group of patients.

CONCLUSION

In conclusion it is felt that the loss or absence of suppression was the cause of the intractable diplopia in these patients. It is apparent that suppression is an important natural defence mechanism against disruption to the normal binocular sensory adaptations, therefore orthoptists should be particularly discerning about the presence of true fusion before carrying out vigorous suppression treatment because it seems

that contrary to common belief children do not always learn to resuppress easily once it has been eliminated.

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THE MILLER FISHER SYNDROME

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Abstract:

Fisher's syndrome is a neurological condition rarely described in the ophthalmic literature. The characteristics of this syndrome, external ophthalmoplegia, ataxia and areflexia are noted and two case histories are discussed.

Key words: *Ophthalmoplegia, ataxia, areflexia, diplopia, polyneuritis, ptosis, pupil response.*

INTRODUCTION

In 1956 Miller Fisher reported three cases of an acute neurological illness, in which there was a triad of "total external ophthalmoplegia, severe ataxia and loss of the tendon reflexes". Since the original description about thirty cases have been reported in the literature and this condition has become known as The Miller Fisher syndrome.

There is however very little written in the ophthalmic literature about these patients. Diplopia is often the presenting symptom and ocular signs are generally marked, including: moderate ptosis, symmetrical, complete external and almost complete internal ophthalmoplegia, sluggish pupil reaction to light.

As it is an acute atypical form of idiopathic polyneuritis, symptoms are not confined to the eyes. The most common other clinical findings are: dizziness, severe ataxia, loss of tendon reflexes, chest pain, difficulty chewing, diminished or absent sense of vibration, numbness of fingers.

The course of this disease is about three months and according to the ophthalmic literature^{1,2,3} recovery is spontaneous.

As this syndrome is rare it was of great interest that two cases presented to the orthoptic department within a couple of weeks of each other.

The first patient was a 16 year old male referred from the casualty department for orthoptic assessment. His appearance was deceptive and the first reaction to his ocular and general signs was one of drug abuse. Diagnosis was complicated by a history of trauma five days previously. On presentation no ptosis was evident but he had very restricted ocular rotations with nystagmoid movements, diplopia, and sluggish pupil reaction to light and accommodation. The diplopia was difficult to join with prisms due to the lack of motor fusion and the variability of the angle size. A patch was used for comfort and management involved monitoring progress and reassurance. Recovery was complete within three months.

When the second case, a 34 year old male, was seen some degree of spontaneous recovery had already taken place. The diagnosis of Miller Fisher syndrome was made by the neurologist. At the time of referral to the orthoptist the patient was complaining of diplopia resulting

from an intermittent convergent squint of 10 to 14 prism dioptres. There was underaction of both lateral recti muscles. He was encouraged to remove his glasses briefly (high myope) in order to join the intermittent diplopia. Final recovery was achieved after surgery, approximately eighteen months after onset.

Definitive diagnosis of this syndrome requires full neurological examination. Initially the clinical picture is striking and the orthoptist's

main role is help relieve diplopia and monitor progress while recovery takes place.

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VISUAL FUNCTION IN FIFTY-EIGHT INTELLECTUALLY HANDICAPPED CHILDREN

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Abstract

Fifty-eight children from opportunity class type "A" were screened. The aim was to evaluate the type and incidence of ocular defects in these children. The results revealed that 50% of the children had significant ocular defects, which is a higher incidence of defects than is found in the average school population.

Key words: *Intellectually handicapped children, Wisc-R test, vision dependent subtests, Guy's colour plates.*

INTRODUCTION

A screening programme was undertaken in four public schools in the northern metropolitan area of Sydney to determine the incidence and type of ocular defects found in intellectually handicapped children. Fifty-eight children classified as "OA" that is Opportunity Class Type A were examined.

To obtain a position in an OA class a child must satisfy one or more of the following three criteria:

1. that his intelligent quotient determined by the Wechsler Intelligence Scale for Children — Revised, also referred to as the WISC-R, is within the range 70 to 90
2. that he has an obvious or specific difficulty in reading or writing
3. that he has an obvious emotional or social problem.

The WISC-R test assesses a child's intellectual ability on Verbal and Performance Scales and is comprised of the following 12 subtests:

Information, Similarities, Arithmetic, Vocabulary, Comprehension, Digit Span, Picture Completion, Picture Arrangement, Block Design, Object Assembly, Coding and Mazes. Sattler¹ states that according to Allen and Jefferson vision is essential for 10 out of the 12 subtests. They also point out that adaption (of the tests) is not feasible if vision is absent or more than mildly impaired. Sattler² agrees, particularly as regards the subtests in the Performance Scale. He states that, "the picture completion subtest can only be given to a child who is able to see".

Studies which have been performed on mentally retarded children reveal that they usually obtain significantly higher WISC Performance Scale IQ's than Verbal Scale IQ's. However the use of such vision dependent subtests raises the question of whether this may mask the innate intellectual ability of the OA child.

Bankes³ states "that the earlier and better the visual sense functions then the greater the chance the child has of achieving his potential".

METHOD

The 58 children screened ranged in age from 7 to 13 years, of these 75% were boys and 25% were girls. Each child was screened at his public school in a familiar environment. Hence the children were not disturbed by the examination and their vision was easily assessed. Hatfield⁴ states that Blackhurst and Radke found there was little or no need to modify normal testing procedures for the mildly retarded or educable child.

A routine examination was performed on each child. This comprised the following tests:

1. Observation: to disclose obvious ocular defects such as nystagmus, strabismus, ptosis, abnormal head postures or to note the presence of physical abnormalities like hemiplegia.
2. Cover test near.
3. Cover test 6 metres.
4. Cover test far distance — this was only included if a larger exophoria was demonstrated at 6 metres.
5. Ocular movements — gross abnormalities only were recorded including obvious muscle palsies, A or V patterns or specific ocular syndromes such as Duane's Retraction Syndrome.
6. Visual acuity. Vision was assessed monocularly for near and distance using a Sheridan Gardiner linear or single letter chart and an appropriate near test type.
7. Fixation behaviour was assessed in those children who demonstrated a difference in distance vision of one line or more.
8. Convergence was assessed on the RAF rule and repeated three times to check for fatigue.
9. Accommodation was assessed binocularly and monocularly on the RAF rule.
10. Binocular single vision was assessed using either Wirt/Titmus, TNO Random Dot or Lang's Pen Location test.
11. Colour vision was assessed by either Guy's Colour Plates for Young Children or Ishihara Colour Plates.
12. Maddox Wing.
13. Hand/eye dominance.

No assessment of the child's visual field was obtained.

RESULTS

Only the most significant results will be discussed.

Squint: Overall 20.6% of the children were found to have either an intermittent or constant strabismus. 6.9% had an intermittent strabismus most commonly an intermittent exotropia and 13.7% had a constant strabismus most commonly an esotropia.

Muscle abnormalities: 32 children were found to have no abnormality of extra ocular muscle function, however 26 children had one or more extra ocular muscle defects. The most common defect was slight overaction of the inferior oblique muscles associated with a normal physiological V pattern but not accompanied by ipsilateral superior oblique underaction. Nine children had diplopia on elevation and demonstrated a significant V exo pattern. One had an A eso and one a V eso pattern.

Convergence: Of the 50 children with heterophoria or intermittent strabismus, 48% had full convergence near points to 5 cms while 20% demonstrated a convergence near point of 8 cms or less.

Visual Acuity Standard: 31% of the children were found to have reduced vision in one or both eyes.

22.4% had unilaterally reduced vision that is a difference of one line or more between the two eyes.

8.6% had bilaterally reduced vision that is each eye had an acuity of 6/9 or less.

13.7% had vision of 6/12 or less in one or both eyes.

8.6% had near vision of N6 or less in one or both eyes.

Eccentric fixation: this was found in 12 children; four demonstrated eccentric fixation in the right eye only; two demonstrated eccentric fixation in

the left eye only, while six demonstrated bilateral eccentric fixation.

Stereopsis: 56.9% of the children demonstrated full stereo acuity on Wirt Stereo testing.

Colour vision: this was assessed in 23 children using Guy's Colour Plates. Seven girls and 16 boys were tested. Only 3 children had normal colour vision responses to all plates and 20 children had defective responses on one or more plates.

The defective responses to Guy's Colour Plates were made on only five out of the eight plates. Plates 5 and 6 were the two plates most commonly mistaken. 75% incorrectly named Plate 5 while 65% incorrectly named Plate 6.

Halfway through the screening programme we changed to Ishihara Colour Plates and of the 37 children tested 36 had normal colour responses to each plate and one child saw the control plate only — indicating total achromotopsia.

Interestingly two children were tested on both plates and the results showed that the child who made no errors on Ishihara saw plates 4, 5 and 6 incorrectly on Guy's. The child who demonstrated total achromotopsia on Ishihara saw plates 1, 2, 7 and 8 correctly on Guy's.

With such a large percentage of children scoring incorrect responses on Guy's Colour Plates one begins to question the validity of this test. We would certainly agree with McKenzie⁵ that the Guy's Colour Plates are not suitable for the mass screening of children for the detection of colour vision abnormalities.

Many of the OA teachers reported that a large proportion of the children had difficulty with letter and number reversal.

Hand/eye dominance: our crude assessment of the hand/eye dominance of each child revealed that 31% had crossed dominance. This percentage is consistent with a study done by Woods⁶ who found 29% of these children had hand-eye confusion.

A summary of the defects revealed that 50% of the children had an ocular defect such as

amblyopia, strabismus, convergence insufficiency or a combination. Of these 50%:

20.6% had a convergence insufficiency of 8 cms or less, not associated with any other ocular defect.

27.5% had reduced vision not associated with any other ocular defect.

10.3% had a strabismus not associated with any other ocular defect.

41.3% had a combination of two or three defects.

Of interest were:

One child with a bilateral superior oblique palsy

One child with a left superior oblique palsy

One child with a left Duane's Retraction Syndrome with an abnormal head posture

One child with anisocoria

Five children with refractive error corrections

Two children with ptosis

One child with a positive angle alpha

Three children with nystagmus

One child with cerebral palsy

Two children with hemiparesis

One child with hemiplegia

One child with ataxia.

This study has revealed a significantly higher incidence of ocular defects in children classified as intellectually handicapped as compared to the normal child.

Our figure of 50% is consistent with Edwards, Price and Weisskopf⁷ who in 1972 found 53% of children with an IQ range 70 to 85 had an ocular diagnosis.

Blackhurst and Radke as quoted by Hatfield⁴ found the incidence of vision defects among the mildly retarded to be approximately double that of children in normal grades.

Of the children found to have ocular defects, only 13.7% were receiving eye treatment while 32.2% had an eye problem which was previously undetected and therefore untreated. Only one child complained of symptoms.

CONCLUSION

Intellectually handicapped children would seem therefore to be at risk in two ways. Firstly their eye problems seem largely to go unrecognised

and thus untreated. Secondly, because of the high visual dependence of the IQ tests these children are subjected to, the results may well underestimate their intellectual potential.

There is a need therefore for greater awareness of the importance of assessing the visual function of intellectually handicapped children.

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THE EFFECTS OF ALCOHOL ON THE VISUAL AND OCULAR MOTOR SYSTEMS

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Abstract

Alcohol is generally considered to be a central nervous system (CNS) depressant. This effect is progressive from higher cortical centres through to fundamental body functions. The effect of alcohol ingestion on the visual and ocular motor systems of ten healthy subjects was the basis of this study. Significant changes in the following, resulted from the ingestion of 0.375 g/kg body weight of 10% ethanol alcohol:

- (i) prism measurements of deviations for near and distance
- (ii) ocular movements
- (iii) convergence near point
- (iv) visual acuity at 6 m

No significant change was observed following testing of stereopsis or near visual acuity.

Key words: ethanol alcohol, deviation, convergence near point, stereopsis, ocular motility, visual acuity.

INTRODUCTION

Alcohol is generally considered to be a central nervous system depressant (CNS), having properties in common with general anaesthetic substances, appearing to depress the midbrain reticular activating system.¹

Generally the depressant effect is progressive from higher cortical centres (thinking, learning, remembering and making judgement) to more fundamental functions of the body (speech, gait, perceptions and discriminations).

The effect of alcohol on the brain is rather biphasic in that low concentrations serve as a stimulant of certain functions which become progressively more depressed as the concentration increases. Depression of the cortical centres that control muscular activity will not only manifest itself in a reduced sense of balance, staggering gait and slurred speech, but also it is likely that uncoordination of extrinsic and

intrinsic ocular muscles will result from depression of the reticular activating system and paramedian pontine reticular formation.

Much has been written about the effects of alcohol on eye movements. Wilkinson² reports a reduction in peak saccadic velocity and interruptions to smooth pursuit movements with increasing blood alcohol concentrations (BAC). Cogan and others³⁻⁵ have outlined the tendency with increasing BAC for heterophorias to become more esophoric for distance fixation and more exophoric for near.

In his profile of the alcoholic driver, Reynolds⁶ presents studies that suggest a reduction in intraocular pressure, changes in dynamic visual acuity, sinusoidal and oculomotor tracking, as well as colour discrimination and peripheral gaze nystagmus with increasing BAC. Changes in visual search behaviour became evident with increasing concentrations as did decreased

This paper was written whilst the author was a third year student in Orthoptics at the Cumberland College of Health Sciences, N.S.W.

sensitivity to contrast at low levels of illumination.

Other studies⁷⁻⁹ have related normal visual acuity and slowing of visual evoked potentials following alcohol ingestion.

It appears that little if any research has been undertaken involving changes to stereopsis, convergence or ocular motility resulting from the ingestion of specific quantities of alcohol.

This study therefore examines the effects of alcohol ingestion on the prism measurement for near and distance deviations, visual acuity near and distance, stereopsis, convergence and ocular motility.

METHOD

A total of ten healthy subjects (five male and five female) were chosen. All were members of a local volleyball team and partook in a regular fitness program. All were aged between 19 and 28 (mean 21.5) and weighed between 45 and 101 kg (mean 70.4). None were under any form of medication and all had moderate drinking habits.

The experiment was undertaken in the Psychopharmacological Research Unit of the Rozelle Hospital under the supervision of Professor Graham Starmer of the University of Sydney.

Subjects were instructed to consume a light non-fatty breakfast two hours prior to their stated drinking time and requested not to smoke on the morning of the experiment until all measurements had been completed.

Each subject was weighed five minutes prior to stated drinking time and given a dosage of 0.375 g/kg body weight of 10% ethanol alcohol (v/v EtoH) in orange juice (unsweetened, no preservatives or additives). Twenty minutes drinking time was allowed immediately after which two measures of breath alcohol concentrations (BAC) were taken using the Intoximeter IV (gas chromatograph type) and the Intoximeter 3000 (infra-red type). Alcohol dosage resulted in a mean level of 0.052% and 0.047% respectively which would be approximately 0.010% to 0.015% lower than actual blood levels. A constant blood:breath alcohol ratio is assumed throughout this study.

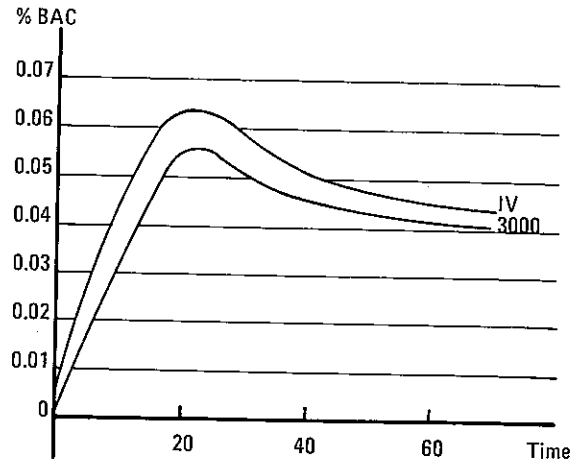


FIG 1: Mean BAC

Control measurements were taken prior to alcohol ingestion (T0) then at twenty minute intervals post-ingestion for one hour (T20, T60). Subjects' near and distance deviations were measured with prisms using an accommodative controlled target. Ocular movements were studied using a torch and an opaque occluder and, depending upon the presence of any change, graded according to whether this change was slight, moderate or large. The convergence near point (CNP) was measured using the RAF Rule and note was made as to the presence of voluntary convergence. Stereopsis was tested

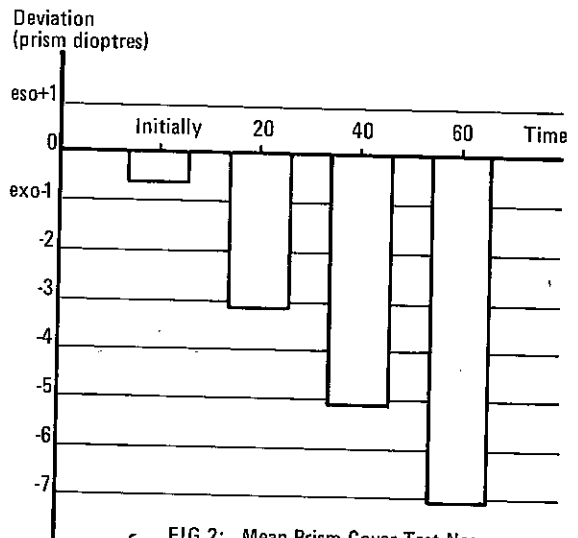


FIG 2: Mean Prism Cover Test Near

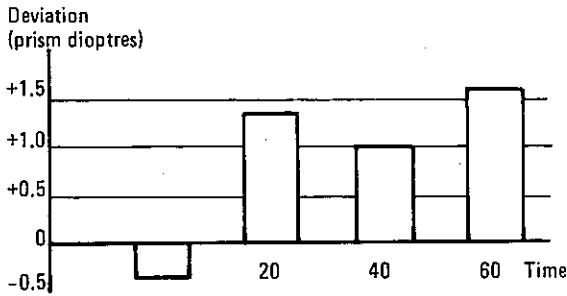


FIG 3: Mean Prism Cover Test Distance

using the TNO Random-Dot Stereo test and was performed at 33 cm under a strong light. Visual acuity was tested at both 1/3 m and 6 m, monocularly and binocularly using Snellen's test type for distance and Moorfields Bar Reading Book for near.

RESULTS

Figure 1 shows the mean BAC recorded on the subjects using both the Intoximeter IV and the Intoximeter 3000. The graph can be seen to consist of an ascending period to a peak at about T20 then gradually descending values until theoretically at approximately three hours post-ingestion the BAC will be back to zero.

An analysis of variance (at p 0.01 level) was carried out on mean prism measurements for near and distance deviations. A significant increase in mean near exophoric measures

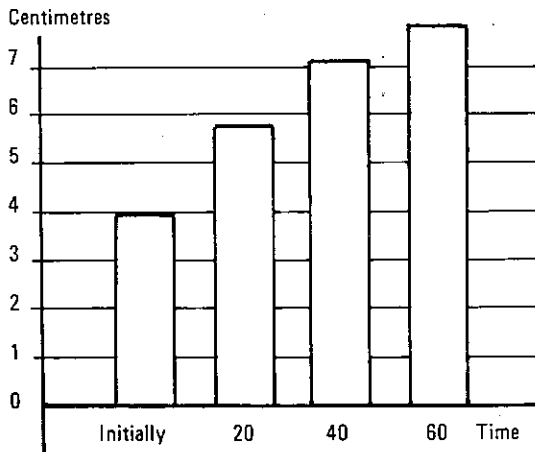


FIG 4: Mean Convergence Near Point

(Figure 2) and mean distance esophoric measures (Figure 3) was found over the specified time period (occasions).

The mean CNP over occasions is shown in Figure 4. An analysis of variance reveals a significant decrease in the mean standard over T0 to T60 (p 0.01).

An analysis of variance for changes in mean stereopsis over occasions was not significant at the 0.01 or 0.05 levels.

Changes in mean distance visual acuity were significant at the 0.05 level (see Figure 5)

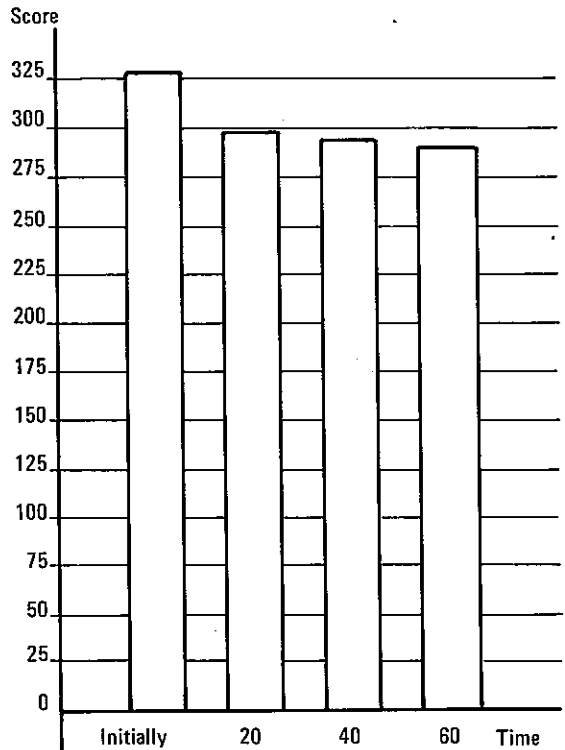


FIG 5: Mean Distance Visual Acuity

using

VA	6/5	6/6	6/9
Score	18	11	5

showing a reduction in visual acuity with increasing BAC over occasions. Near visual acuity however remained constant (N5 right, left and binocularly) throughout the study.

Changes in ocular movements over occasions are shown in Figure 6.

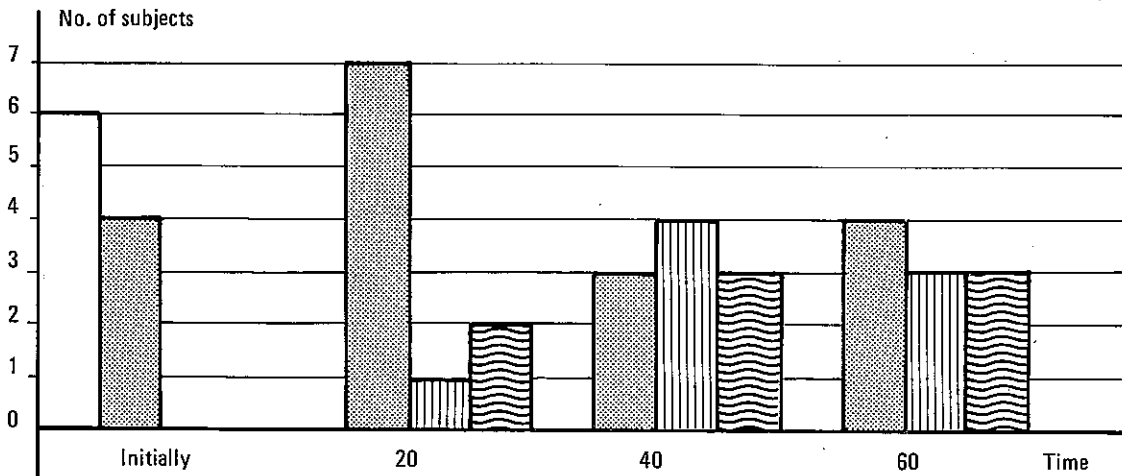
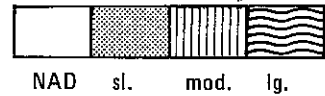


FIG 6: Ocular Movement Changes

All subjects showed varying degrees of inferior oblique overaction and associated 'V' pattern.
 One subject developed a superior oblique underaction associated with the above.
 Six subjects developed an intermittent divergent squint elevation.

DISCUSSION

The results of this assessment confirm previous reports mentioned, that following alcohol ingestion there is a tendency for near deviations to become more exophoric and distance deviations to become more esophoric.

It is interesting to note that the peak mean BAC was 0.0628%, marginally higher than the legal limit for this state, and the presence of abnormalities was just as evident here as in those studies where mean BAC were as high as 0.08% to 0.11%. Although the mechanism here is not clearly understood, Fender¹⁴ says "the muscles that move the visual axis from side to side are quite sensitive and capable of precise movement" in comparison to the vertically acting muscles which act in a 23° plane rather than a vertical plane. Vertical phorias therefore tend to be more resistant than the horizontal phorias to fatigue (elicited by alcohol).

Powell⁷ believes that the distance esophoria may be "due to a diminished muscle tonus and

muscular control", whereas for near there is a "reduction of the convergence that is associated with accommodation due to either a decrease in muscular tone or an inefficiency of the associative centre," resulting in an exophoric shift for near.

A reduced convergence standard (Figure 4) may thus be related to a reduction of accommodative convergence and an associated reduction in muscle tonus, however proximal and fusional convergence would still be active, thus a constant reduction is evident over T40 to T60. No change was however noted in near visual acuity, suggesting that accommodation is intact. Obviously examination of accommodation under similar testing conditions is necessary before this can be assumed. Stereopsis showed no significant alteration since horizontally disparate similar images remain within fusible limits on the two retinae — the clear stimulus remains intact.

A significant reduction in visual acuity for distance (p 0.05) was established following

alcohol ingestion, which is inconsistent with previous studies. Two subjects complained prior to testing that they were experiencing blurred vision.

A marked change occurred when testing ocular movements. All subjects developed some degree of inferior oblique overaction from slight unilateral overaction to marked bilateral overaction with associated "V" exo pattern, which in four subjects became decompensated on elevation. These four subjects experienced heteronymous diplopia in dextro elevation, elevation and laevo elevation. Two of these subjects developed manifest deviations on elevation at T20, one at T40 and one at T60, all of which remained throughout the period of testing. In three of these cases an intermittent alternating divergent squint was evident on elevation without dissociation and in one case following dissociation. In only one instance was there an associated unilateral superior oblique underaction which became an intermittent divergent squint on elevation.

It is interesting to note that two other subjects developed end point nystagmus at T20 and T40 respectively. Howells¹¹ states that a minimum of 50 ml of ethyl alcohol is required to induce nystagmus, itself accentuated by changing directions of gaze and positions of the head. All six subjects mentioned thus far experienced trouble maintaining steady fixation and refixation, one of which consistently overshot refixation on depression and in the primary position over T40 to T60.

Two of the ten subjects tested showed unequal pupil reactions (direct and consensual) to light, one eye being more sluggish than the other. One subject from T40 to T60 experienced rapid blinking which increased on convergence.

Wilkinson, Kime and Purnell² stated that "alcohol affects cerebral function earlier and to a greater extent than mid-brain and brainstem function," to explain impairments in smooth pursuit and saccadic movements after alcohol, in contrast to normal doll's head movements. Interrupted cortical control over the extra ocular muscles possibly induces a tendency to deviate towards the anatomical position of rest, thus

inducing divergence on elevation. Impairment to both smooth pursuit and saccadic movements explains difficulties of fixation and refixation whereas decompensation in the primary position and in other directions of gaze can be expected with increasing doses of alcohol.

Further studies on the effect of alcohol could be carried out firstly to examine the effects of alcohol on visual fields, dark adaptation and accommodation, and secondly a follow up of this study to examine increasing doses of alcohol and the levels at which subsequent changes become significant.

CONCLUSION

It is clear from this study that blood alcohol concentrations as low as 0.05% (the legal limit in NSW) elicit rather dramatic changes in the visual and ocular motor systems. This can be related to the performance of certain ocular motor skills, such as driving, in which hand-eye coordination may be affected. The respective shifts in distance and near deviations will alter judgement perceptions, i.e. esophorias tend to overestimate distances whereas exophorias underestimate.

Ramifications of this alone, not to mention the effects of other visual and ocular motor disturbances discussed, extend to areas of driving, water sports and any situation involving machinery such as a factory production line or a fork lift driver etc. Combine this with the proven impairment of cognitive performance¹² following alcohol ingestion and it can be seen that alcohol is a drug providing limitations to daily activity yet one which encourages such activity beyond safe limits.

ACKNOWLEDGEMENTS

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RESULTS OF LION'S CLUB AMBLYOPIA SURVEYS

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Abstract

This paper presents the findings of the visual screening programme conducted by orthoptists under the organisation of the Lion's Clubs of Victoria. During the period from May 1980 to August 1982, 6,515 children were tested and a referral rate of 6.83% was found.

Key words: Visual screening, ocular motility disorder.

INTRODUCTION

This paper presents the results obtained in the Victorian Lion's Club amblyopia surveys performed between May, 1980 and August, 1982.

METHOD

These surveys are conducted at weekends, testing children in the age group of four to six years in their local area, usually in schools or town halls.

The following tests are performed:

- cover test, 1/3 metre and six metres
- visual acuity, E chart, six metres
- ocular movements
- convergence near point.

The children are referred for a full ocular examination if they exhibit any one of the following:

- (a) visual acuity less than 6/9 in either eye
- (b) manifest deviation
- (c) large or decompensating latent deviation
- (d) significant convergence insufficiency
- (e) visual acuity of 6/9 if there are other indications, e.g. family history of myopia.

RESULTS

Of the 6,515 children tested, 445 (6.83%) were referred for further investigation.

TABLE 1
Type of Defect Found

Type of defect	Amblyopia	No Amblyopia	VA Unobtainable	Total
Constant esotropia	23	6	1	30
exotropia	4	6	1	11
hypertropia	0	1	0	1
Intermittent esotropia	8	6	0	14
exotropia	6	43	2	51
Heterophoria	4	5	1	10
Convergence insufficiency	0	3	0	3
Ocular motility disorder	4	8	0	12
Total	49	78	5	132

Of these 445 children referred, 313 (4.8%) had some degree of amblyopia with no deviation of the visual axes, and 132 (2.03%) had either a squint or other ocular motility disorder. From Table 1 it can be seen that the most common conditions detected were intermittent exotropia, the majority having no amblyopia, and constant esotropia, most presenting with amblyopia.

CONCLUSION

It is interesting to note that of the 445 children referred, 78 (17.5%) were found to have a squint or ocular motility disorder but had vision in both eyes of 6/9 or better.

These results again show the importance of the cover test and ocular movements being performed by trained personnel, as well as visual acuity tests in the visual screening of children.

AUSTRALIAN CONTRIBUTION TO INTERNATIONAL ORTHOPTIC ASSOCIATION SURVEY

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Abstract

At the meeting of the Permanent Scientific Committee of the International Orthoptic Association held in Berne, Switzerland in September 1979, it was decided to collect data on the relative incidence of esotropia and exotropia over a 12 month period relating this to latitude, hours of sunlight and race. Later additional data was suggested including age of onset, type of deviation whether congenital or acquired, constant or intermittent, comitant or incomitant and the presence or absence of refractive error and amblyopia for each case. Each member country's representative was to be responsible for collecting data from her country. A pro-forma was prepared and sent out with explanation.

Members of the Orthoptic Association of Australia were sent these pro-formas and 26 clinics returned usable data. A total of 2620 valid cases were obtained and the data from these was stored in a computer. This paper presents preliminary analyses relating type of deviation and latitude to the other variables.

Key words: *Incidence of esotropia, incidence of exotropia, latitude, sunlight, race, type of deviation, onset, refractive error, amblyopia.*

INTRODUCTION

A survey document requesting information relevant to the International Project was circulated to orthoptic practices throughout Australia. Data, for each practice, over the past 12 months for cases of esotropia and exotropia was obtained, along with the sex, age, race, whether congenital or acquired, constant or intermittent, comitant or incomitant, presence or absence of a refractive error and presence or absence of amblyopia, for each such case.

The authors assigned latitude and yearly sunlight to each return on the basis of astronomical and meteorological data. All data were coded and placed on computer tape for analysis using the Statistical Package for the Social Sciences (SPSS).

RESULTS

Returns to the survey were obtained from a total of 26 practices. A total of 2620 valid cases were

obtained with 1390 (53%) being female and 1230 (47%) being male. The age range for the sample was newborn to 88 years of age; the modal and median ages being 7 years with a mean of 10.5 years (± 12.11 years).

There were 1794 (69%) esotropias and 825 (31%) exotropias. Cross tabulations of deviation type by various variables will be discussed below.

Cross tabulation of deviation by sex can be seen in Table 1. From the percentages in this table there appears to be marginal differences between males and females in the type of deviation that they have ($\chi^2 = 0.73$, N.S.).

Examination of type of deviation by age at first presentation, Table 2, reflects the age distribution of the sample described above. Although the numbers are small beyond the 20 year age group, as one would expect there is an increase in the number of exotropias with age. In the younger age groups (12 years of age and

TABLE 1
Type of deviation by sex

Sex	Deviation			
	Esotropia		Exotropia	
	No.	%	No.	%
Female	942	36	448	17
Male	852	33	377	14
Total	1794	69	825	31

less) 64% of the total are esotropic while 22% exotropic.

Table 3 is the cross tabulation of deviation by race. As can be seen 98.6% of the total sample are of European origin. No relationship between the two variables here presented is apparent.

TABLE 2
Type of deviation by age

Age categories	Deviation			
	Esotropia		Exotropia	
	No.	%	No.	%
0-3	430	18	93	4
4-7	683	29	229	10
8-12	400	17	184	8
20-29	59	2	76	3
30-39	31	1	56	2
40-49	13	0.5	25	1
50-59	10	0.5	20	1
60-69	9	0.5	15	0.5
70+	13	0.5	14	0.5

As can be seen in Table 4, 49% of the sample were classified as congenital and 51.5% as acquired. There appears to be no difference

TABLE 3
Type of deviation by race

Race	Deviation			
	Esotropia		Exotropia	
	No.	%	No.	%
Unknown	0		2	0.1
Southern				
European	189	7.2	94	3.6
Northern				
European	1591	60.7	710	27.1
Negro	3	0.1	0	
Aboriginal	2	0.1	0	
Asiatic	9	0.3	19	0.7
Total	1794	68.5	825	31.5

between the incidence of either congenital or acquired esotropias or exotropias. A chi-square test reveals the prevalence of esotropia in both onset categories ($\chi^2 = 71.40$, $P < 0.001$).

Table 5, below, shows the type of deviation by periodicity, i.e. constant versus intermittent. A chi-square analysis of this data yielded $\chi^2 = 29.691$ ($P < 0.001$). It can be seen in the table that there are more constant esotropias (45%)

TABLE 4
Type of deviation by onset

When Acquired	Deviation					
	Esotropia		Exotropia		Total	
	No.	%	No.	%	No.	%
Congenital	979	37	304	12	1283	49
Acquired	805	31.5	518	20	1324	51.5
Not known	10	0.4	3	0.1	13	0.5

than intermittent esotropias (23%), i.e. almost 2 to 1. The situation is reversed for exotropias, the ratio being 2 to 1 intermittent exotropias to constant exotropias.

A chi-square test of the relationship between deviation type and comitance (Table 6) yielded a non-significant value ($\chi^2 = 1.02$). That is to say

TABLE 5
Type of deviation by periodicity

Periodicity	Deviation					
	Esotropia		Exotropia		Total	
	No.	%	No.	%	No.	%
Constant	1179	45	243	10	1422	55
Intermittent	611	23	580	22	1191	45

there is no variations between the levels of these two variables. This can be seen in Table 6 where there are more concomitant squints than incomitant squints for both deviation types.

Although the majority (60.6%) of the subjects had a refractive error analysis of type of deviation by refractive error yielded a significant difference between esotropias and exotropias ($\chi^2 = 242.6$, $P < 0.001$). It can be seen (Table 7) that the majority of esotropias have a refractive error while the majority of exotropias do not

TABLE 6
Type of deviation by comitance

Comitance	Deviation					
	Esotropia		Exotropia		Total	
	No.	%	No.	%	No.	%
Not known	6	0.2	2	0.1	8	0.3
Concomitant	1449	55.3	652	24.9	2101	80.2
Incomitant	340	13.0	171	6.5	511	19.5

have a refractive error. The greatest proportion (48.4%) of the total sample are esotropic with a refractive error.

Consideration of the relationship between type of deviation and presence/absence of amblyopia (Table 8) yielded some interesting results. One can see that there appears to be little difference in the number who presented with amblyopia (46%) and the number who presented without

TABLE 7
Type of deviation by refractive error

Refractive Error	Deviation					
	Esotropia		Exotropia		Total	
	No.	%	No.	%	No.	%
Not known	8	0.3	7	0.3	15	0.6
Present	1270	48.4	319	12.2	1589	60.6
Absent	517	19.7	499	19.0	1016	38.8

amblyopia (54%). A chi-square analysis yielded a significant difference ($\chi^2 = 158.57, P < 0.0001$) between the two variables, approximately equal numbers of the esotropes were distributed between the other two categories, however of the exotropes the ratio of amblyopia absent to amblyopia present is greater than two to one.

When residential latitude was assigned to the various returns it was found that patients had

TABLE 8
Type of deviation by amblyopia

Amblyopia	Deviation					
	Esotropia		Exotropia		Total	
	No.	%	No.	%	No.	%
Present	960	37	226	9	1186	46
Absent	798	31	583	23	1381	54

come from as far south as 46°S to as far north as 27°S, which correspond to Hobart and north of Brisbane (including Alice Springs and Mount Tom Price). As we would expect the greatest number of returns came from the larger centres of population and this is reflected in the data in Table 9. Melbourne (38°S), Adelaide and

TABLE 9
Type of deviation by residential latitude

Residential Latitude	Deviation					
	Esotropia		Exotropia		Total	
	No.	%	No.	%	No.	%
North of 27°S	23	0.8	12	0.5	35	1.3
27°S	36	1.4	59	2.2	95	3.6
31°S-28°S	15	0.5	11	0.4	26	0.9
32°S	345	13.2	81	3.0	426	16.2
33°S	220	8.4	71	2.7	291	11.1
34°S	394	15.3	280	10.7	674	26.0
35°S	458	17.5	184	7.0	642	24.5
37°S-36°S	61	2.3	79	3.0	140	5.3
38°S	196	7.5	24	0.9	220	8.4
46°S-42°S	46	1.8	24	0.9	70	2.7

Canberra (35°S), Sydney, Wollongong and Esperance (34°S), Newcastle (33°S), Perth and Broken Hill (32°S), Brisbane (27°S) are the principal areas of population for which data has been obtained. Categorisation of the variable latitude proved difficult since we wished to eliminate population size bias while still retaining

TABLE 10
Type of deviation by annual hours of sunlight

Hours of Sunlight	Deviation					
	Esotropia		Exotropia		Total	
	No.	%	No.	%	No.	%
3200+	20	0.8	6	0.2	26	1.0
2800-3100	167	6	39	1.5	206	7.5
2500-2800	512	20	229	9	741	29.0
2200-2500	844	32	458	17	1302	49.0
1900-2200	250	10	93	3.5	343	13.5
1000-1300	2	0	0	0	2	0

a fair range of latitude. A chi-square analysis of the data in Table 9 yielded a significant value ($\chi^2 = 198.05, P < 0.001$) which indicates some variation in deviation type by latitude, however it can be seen that there is no distinct preference

for one deviation type with a change in latitude, but rather a random change.

On the basis of the marginal totals of esotropias to exotropias one would expect to find twice as many of the former than the latter of each latitude. If a trend with latitude was to be apparent we should have a reversal in this ratio

TABLE 11
Residential latitude by type

Residential Latitude	Type			
	Concomitant		Incomitant	
	No.	%	No.	%
North of 27°S	29	1.1	6	0.26
27°S	93	3.5	2	0.07
31°S-28°S	24	0.9	2	0.07
32°S	347	13.2	79	3.0
33°S	243	9.3	48	1.8
34°S	518	19.8	156	6.0
35°S	519	19.8	123	4.7
37°S-36°S	107	4.1	33	1.3
38°S	162	6.2	58	2.2
46°S-42°S	63	2.4	7	0.3

which remains constant with an increase/decrease in latitude.

Comments similar to the above can be made regarding analysis of duration type by annual hours of sunlight (Table 9). We are told that

TABLE 12
Residential latitude by periodicity

Residential Latitude	Periodicity			
	Constant		Intermittent	
	No.	%	No.	%
North of 27°S	21	0.8	14	0.5
27°S	48	1.8	47	1.8
31°S-28°S	13	0.5	13	0.5
32°S	276	10.5	150	5.7
33°S	91	3.5	200	7.6
34°S	387	14.8	287	11.0
35°S	372	14.2	270	10.3
37°S-36°S	62	2.4	78	3.0
38°S	122	4.7	98	3.7
46°S-42°S	34	1.3	36	1.4

Australia has more than its share of sunlight and to obtain a finer categorisation than that presented in the data would have resulted in ridiculously small numbers in many more sunlight categories.

One would expect a distribution of two esotropias to each exotropia for each category of sunlight hour but in the majority of cases the ratio equals or exceeds three esotropias per exotropia ($\chi^2 = 27.52$, $P = 0.001$). It appears, then, that there are more esotropias than exotropia than would normally be expected for variation in sunlight hours.

To some extent hours of sunlight can be related to latitude however the difficulty in terms of obtaining satisfactory categories for the former variable led us to complete comparisons on the basis of residential latitude.

Analysis of latitude by comitance (Table 11) yielded $\chi^2 = 40.30$ ($P = 0.001$), indicating that the distribution of concomitants to incomitants was

TABLE 13
Residential latitude by onset

Residential Latitude	Onset			
	Congenital		Acquired	
	No.	%	No.	%
North of 27°S	18	0.7	17	0.6
27°S	30	1.1	65	2.5
31°S-28°S	14	0.5	12	0.5
32°S	279	10.6	147	5.6
33°S	140	5.3	151	5.8
34°S	381	14.5	293	11.2
35°S	247	9.4	395	15.2
37°S-36°S	52	2.0	88	3.4
38°S	84	3.2	136	5.2
46°S-42°S	44	1.7	26	1.0

not uniformly distributed by latitude. Under the marginal totals one would expect four concomitant deviations to each incomitant deviation. However, there is a marked deviation away from this ratio in lower latitudes and the extreme of high latitudes.

As discussed above there were approximately equal numbers of constant and intermittent deviations and analysis of this variable, periodicity, by latitude should yield equal numbers for each category for each latitude. A chi-square test leads to the rejection of this hypothesis ($\chi^2 = 95.08$, $P < 0.001$), the difference occurring at latitudes 32°S (Perth/Broken Hill) where there are twice as many constant than

intermittent deviations and 34°S (Sydney, Wollongong and Esperance) where there are half as many constant deviations than intermittent deviations (Table 12).

Table 13 gives the cross tabulation of residential latitude by onset. Although the chi-squared tests indicates a significant variation ($\chi^2 = 125.58$, $P < 0.001$) between these two variables there is no consistent variation apparent. Only two cells have anomalous deviations, viz 27° where there is one congenital

squints for two acquired squints and 32°S where there are two congenital squints for each acquired squint.

CONCLUSION

While no significant variation by latitude and hours of sunlight can be found from the data collected we feel that the principal limitation is the sparse population distribution in Australia with localised maxima especially upon the east coast.

TESTING THE FIELD OF VISION

DOUGLAS R. ANDERSON

C V Mosby Co., St Louis 1982. Price: approx \$55 (Aust).

The complete guide to do-it-yourself field testing, Anderson's book is a boon to the learner as well as to the advanced practitioner of the art and science of perimetry. Anderson, who is Associate Professor of Ophthalmology at Bascom Palmer Eye Institute, Miami, Florida has produced a clear, well illustrated, comprehensive guide to the methods, pitfalls and tricks of visual field testing. Each chapter has, at its end, a summary of

salient points and the scope of the book ranges from a dissection of the Goldmann perimeter through patient education to selection of instrument, technique and topographical classification of visual field defects. The recent (June 1982) publication of this useful book has at long last filled an obvious gap in the literature on clinical perimetry.

Anne McIndoe

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.

NORMAL ADAPTATION RESPONSES TO PRISMS—Meg Hammond

Two groups of orthoptically and neurologically normal subjects, ten in each group, underwent prism adaptation tests over a period of two hours. Measurements of their heterophoria were taken prior to the addition of prisms, immediately after introduction of prisms, at 40, 80 and 120 minutes of prism wear, and immediately on removal of the prisms.

The results of the study show that the 'normal' response entails an initial prism induced heterophoria, with a return towards the basic deviation over time. This study of normals can be used as a basis to compare with patients who have a neurological defect where the site of the lesion is known.

BINOCULAR VISION IN BILATERAL APHAKIA—Jillian Guleksen

Twenty five patients previously operated on for senile cataracts in both eyes, aged between 60 and 87 years of age, were investigated for sensory binocular function. Visual acuity was 6/18 or better in the poorer eye and there was no history of strabismus or other ocular motility problem prior to surgery. The specific test chosen was the Titmus stereotest and there was a statistically significant decrease in stereoacuity levels for their age range.

Deviation type and size, convergence standard, ocular movements and time of operations were also noted. For near, deviation size was increased with 20% of patients being exotropic. Convergence was reduced. Monocular use of the eyes during the period between the operations showed no significant effect on the reduction of stereopsis.

DOES 'NORMAL OCULAR MOVEMENTS' MEAN BALANCED EXTRAOCULAR MUSCLES?—Helen Goodacre

Ocular movement in a group of 50 normal subjects between the ages of 18 and 28 was investigated. Any imbalance found was measured with the Francescetti Maddox Rod and prisms. Ninety-four percent of

subjects demonstrated some extraocular muscle imbalance; 90% showing superior rectus underaction (range 1^{Δ} - 10^{Δ}), and 54% inferior rectus underaction (range 1^{Δ} - 3^{Δ}). The most frequent combinations of muscle imbalances were: bilateral superior rectus underaction—28%, bilateral superior rectus and unilateral inferior rectus underaction—22%, and bilateral superior and inferior rectus underaction—16%. Aetiology of this apparent inefficiency of superior and inferior rectus action, or over efficiency of inferior and superior oblique action is discussed. Mechanical factors such as passive forces of orbital tissue and interaction between the extraocular muscles themselves appear to influence muscle action when the eyes are directed from the primary position.

THE DEVELOPMENT OF OCULAR MOTILITY IN PREMATURE INFANTS—Cathie Searle

The ocular motor functions of twenty one infants born prior to the full term of gestation were assessed using common clinical techniques. The functions tested were fixation, smooth pursuit and saccadic movements (both horizontal and vertical), convergence, prism fusion and optokinetic nystagmus. The results obtained suggest there is a delay in the premature baby's development of precise control of ocular motor function, but these infants do not have to reach the point equivalent to the term baby's age at which a function is acquired. The more complex functions, which require a high standard of binocular co-ordination, take longer to develop. The lower the baby's gestation age, the longer the delay in the development of well controlled functions.

ESTABLISHING NORMS FOR POSITIVE, NEGATIVE AND ABSOLUTE RELATIVE FUSION—Bronwyn Raymond

Norms for positive, negative and absolute relative fusion ranges at thirty three centimetres (33 cm) and six metres (6 m) were obtained from the examination of ninety two orthoptically satisfactory school children ranging in age from five years to nine years. It was found that at 33 cm the average values were 20^{Δ} of positive relative fusion, 10^{Δ} of negative relative fusion and 30^{Δ} of absolute relative fusion. At 6 m the average values were 13^{Δ} of positive relative fusion, 5^{Δ} of negative relative fusion and 18^{Δ} of absolute relative fusion.

ARE ALL A.R.C.'s ECCENTRIC FIXATIONS?—Jennifer Keats

This investigation examined the monocular fixation patterns of 16 patients with some binocular function and a small to moderate sized strabismus. The presence

of binocular function was shown using the Bagolini Striated Glasses, and monocular fixation was assessed subjectively using the Haidinger's Brushes, and objectively using the Oculus Visuscope.

Eleven of the 16 patients examined were found to have eccentric fixation on both the Haidinger's Brushes and the visuscope, one to have eccentric fixation on the visuscope but central fixation on the Haidinger's Brushes, and four patients who had central fixation on both tests. No specific trends between the type of fixation and the size of the strabismus or the visual acuity of the strabismic eye evolved from the investigation, and no other factors were found to be specifically related to the type of fixation.

THE DEVELOPMENT OF OCULAR STANDARDS FROM 3 TO 5 YEARS OF AGE—**Heather Crossman**

Sixty-one (61) children between the ages of three (3) and five (5) years were examined to ascertain the effect of maturation on visual acuity, stereopsis, presence and type of heterophoria, fusion and hand/eye relationships.

It was found that there appeared to be an increase in visual acuity and stereoscopic vision over this time. There also appeared to be an establishment of normal hand/eye relationships. However, the presence and type of heterophoria and fusion range appeared to show no difference between groups.

INCIDENCE, AETIOLOGY AND FIXATION PATTERNS OF OCULAR MOTOR NERVE PALSIES—**Kate Lockett**

The incidence of nerve palsy found in clinics will vary in relation to the orientation of the clinic from which patient selection occurred. From clinics where the emphasis is on ocular motility and paediatric ophthalmology it was found that the IV nerve was most frequently seen as an apparent acquired nerve palsy and that the main cause of the nerve palsy was trauma. In trauma the IV nerve was most vulnerable due to its pathway close to the tentorial edge. Cases of III nerve palsy were seen as both partial and total with varying pupil responses which in some cases aided in aetiology of the palsy. Fixation patterns were also observed where 28% of patients fixated with the affected eye. This was usually due to a difference in the vision between the eyes.

THE EFFECT OF SIMULATED ANISOMETROPIA ON STEREOACUITY—**Gillian Bonhote**

The stereoacuity of 20 subjects with simulated anisometropia was recorded to determine whether there is a relationship between the two. A comparison of the stereoacuity between stimulated unilateral

myopia and hypermetropia was made and also whether the use of TNO or Titmus stereotest made any difference to the results.

Results showed that there is a definite relationship between the amount of anisometropia and level of stereoacuity. The finer levels of stereoacuity were more likely to be recognised in simulated myopia than hypermetropia. Stereoacuity decreased at each increase in lens power. Stereopsis measured on the Titmus exceeded stereopsis measured on the TNO in most cases indicating that the TNO is a more sensitive test for anisometropia than the Titmus test.

Small amounts of anisometropia can significantly decrease the appreciation of stereopsis, emphasizing the importance of prescribing full correction for anisometropia.

COMPARISON BETWEEN CAMBRIDGE STIMULATOR AND OCCLUSION THERAPY IN THE TREATMENT OF AMBLYOPIA—**Karen Baker**

The visual improvement of 160 patients, who had completed treatment for amblyopia using Cambridge Stimulation or occlusion therapy, was the basis of this study. This number consisted of four groups of 40 patients with either astigmatism, strabismus, astigmatism and strabismus or no astigmatism or strabismus.

Results showed that the Cambridge Stimulator was significantly more effective than occlusion therapy in treating astigmatic amblyopia and amblyopia without strabismus or astigmatism. However, occlusion therapy was more effective when strabismic amblyopia was present.

THE VALUE OF THE NEUTRAL DENSITY FILTER IN THE ASSESSMENT OF AMBLYOPIA—**Jane Corday**

Using a group of amblyopic patients, in which the degree of amblyopia ranged from 6/9 to 6/60, the visual acuity of each eye was measured under normal conditions, using Sheridan Gardiner charts at 6 metres. The visual acuity was then measured again, this time using a Kodak Wratten gelatin neutral density filter. One minute of adaptation was allowed after the filter was placed before the patients eye. The visual acuity of the normal eyes consistently decreased by one or two lines. The visual acuity of the amblyopic eyes decreased slightly, remained the same or in some cases improved, indicating that functional amblyopia was present. In one patient there was a marked reduction of visual acuity with the neutral density filter, suggesting that organic amblyopia may be present.

Practically, the neutral density filter can be useful in determining whether the amblyopia is organic or functional, particularly where the amblyopia is of uncertain origin, and thus can give an indication of

possible response to treatment. This test can also determine whether there is an element of functional amblyopia in patients with organic ocular lesions.

INTERDISCIPLINARY UNDERSTANDING—IS IT POSSIBLE?—Pauline Barnard

Increasing emphasis is being placed on the role of the orthoptist in the multidisciplinary approach to assessment and therapy in rehabilitation programmes and centres for the physically and mentally handicapped.

Students from the Schools of Physiotherapy, Occupational Therapy, Speech and Communication Disorders, Medical Record Administration and Nursing at Cumberland College of Health Sciences were interviewed. Questions were asked relating to the training and work of the orthoptist, eye movements and motility disorders and the relevance of these disorders to their respective fields.

The results indicate that wider education is required to achieve better interdisciplinary understanding.

THE EFFECT OF STRABISMUS ON MOTOR CO-ORDINATION—Sarah Dyson

The motor co-ordination of twenty children with constant strabismus aged between four and eleven years of age, was tested using five Basic Motor Ability Tests involving the use of the eyes. When the results were compared to children without strabismus (norms) it was found that the motor co-ordination in these children was reduced on most tests, particularly those requiring judgement of distance. All children studied had no disorder which may have affected the results of the tests. Tests involving static balance showed that these children performed well above average, especially when tested with the eyes closed.

It would be interesting to determine whether a motor therapy programme would improve the co-ordination in these children.

BEHAVIOUR MODIFICATION AND PATCH WEARING—Joanne Vallins

The influence of behaviour modification techniques in patching treatment for amblyopia was assessed using 16 subjects aged between four and eight years. Of these, eight subjects followed a behaviour modification programme while the other eight were given only basic instructions in patch wearing.

Each child's co-operation, shyness and understanding and their parent's understanding, discipline and temperament were recorded. A follow-up visit allowed behavioural changes between the two groups after treatment to be compared.

Results indicate changes in understanding in those following the behaviour modification programme and

to a lesser extent improvement in the child's co-operation and parent's temperament. The monitoring of behavioural changes and their effect on patch wearing with reference to vision improvement is discussed.

AN ACCOMMODATIVE TARGET, DOES IT MAKE A DIFFERENCE?—Pam Waller

Fifty patients were investigated in order to assess deviation changes occurring to accommodative-controlled and accommodative-uncontrolled fixation targets for a third of a metre and six metres on cover testing. These changes were measured by the prism cover test. Eso and exo heterophorias, intermittent squints and constant squints were all assessed. It was found that the majority of eso and exo deviations showed some change in deviation size from the accommodative-controlled target to the accommodative-uncontrolled target, with the majority of patients preferring to relax accommodation on fixation of the accommodative-uncontrolled target.

VARIABLES AFFECTING THE MEASUREMENT OF ACCOMMODATION—Deborah Norman

The amplitude of accommodation was measured using five different methods on 35 subjects aged between 16 and 24 years both monocularly and binocularly. Size of target used, direction the target was moved, amount of blur to be indicated and use of the Duane's cross as opposed to print were looked at.

It was found that there was no significant difference in the apparent amplitude of accommodation when different sized print was used, or when the target was moved toward or away from the eyes. It was necessary to ask for the point of first blur of print as false high amplitudes were obtained when the subject indicated when print was "too blurred to read" or when the Duane's cross was used.

CONVERGENCE REVISITED—John Calligeros

The purpose of this study was to review treatment of convergence insufficiency in Sydney. Data was collected on the types and frequency of exercises given to patients, then this was related to their ocular standard and the presence or absence of symptoms upon discharge. The length of treatment was noted and the types of occupations of the eighty patients whose medical records were reviewed.

Some interesting findings of the study were the high proportion of patients being discharged with less than an optimum ocular standard and the relatively limited range of exercises that were given to many of the patients.

VICTORIA

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

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

COMPARATIVE STUDY OF SELECTED INTRAOCULAR PRESSURE MEASURES—

Matthew Allison, Kerry Fitzmaurice, Julie Green, Peta Gjedsted, Gail Howey, Marilyn Leete, Jean Pollock, Denise Somerville, Nicole Strang, Franca Trifone, Janet Weddall

Key words: *Goldmann applanation tonometry, Schiøtz indentation tonometry.*

Accurate measurement and recording of intraocular pressure (IOP) is imperative in the assessment of the glaucomatous patient and others. Many techniques, methods and instruments exist which aim to give as close as is practicable to the objective IOP of the human eye. These range from finger indentation to Shiøtz, hand-held applanation, and slit lamp applanation tonometries. It was decided to compare the measurements of IOP between the Schiøtz and the slit lamp applanation (Goldman) tonometers, for any non-directional correlation variables, as these were the most readily available and commonly employed clinical methods of measuring IOP.

Some authors feel Goldmann tonometry is the more accurate, thus the preferred method IOP measurements in humans.^{1,2} Comparative studies of various types of indentation and applanation tonometers reveal a somewhat varied relationship between readings obtained by the two methods.

The aim of this study is to determine whether there is a measurable and constant difference between indentation (Schiøtz) and slit lamp applanation (Goldman) tonometry measure of IOP.

METHOD

The control group consisted of 33 subjects (66 eyes). IOP was assessed by applanation and indentation tonometry; seven males and 26 females aged between

18 to 32 years, mean age 20.6 years, were tested. Thirty-seven patients (71 eyes, three patients had only one eye), were assessed by applanation and indentation tonometry. Twelve males and 25 females aged between 21 to 84 years, mean age 66.8 years, were tested.

DISCUSSION

The results of this study were significant, supporting the statement that there is a measurable difference between indentation and applanation tonometry. However, we were unable to show a constant difference. For the control group the difference between mean applanation and mean Schiøtz indicated Schiøtz being greater by 1.39 mmHg whereas the hospital group showed a difference between means of 0.75 mmHg with the applanation being higher.

A varied relationship between readings obtained by the two methods has been found by others.^{1,2} The findings of this present study also indicate a varied relationship. Armaly,³ found a difference of 0.93 mmHg between mean applanation and mean Schiøtz readings with the Schiøtz being the higher. The present study showed where the Schiøtz was the higher reading there was a difference of 1.39 mmHg. However, the current study shows a reversal of the higher reading from Schiøtz to applanation between the control and the hospital groups. A reversal of values was also found by Smith et al.⁴ Other examiners⁴ found the disparity between Schiøtz and applanation rarely exceeded 2.0 mmHg. The findings of this study were also within 2.0 mmHg of disparity.

This study found that within the control group Schiøtz indentation tonometry produces a significantly higher measure of IOP than Goldman applanation tonometry when tested on the same eye. In the hospital group Goldman applanation produces a significantly higher measure of IOP than Schiøtz indentation tonometry when tested on the same eye. A further analysis of the data is being considered.

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