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CONTENTS

CONTENTS

EDITORIAL

Here is a short story with a happy ending. Twenty-two years ago a visiting British orthoptist attended a meeting of our association, and read a paper on "accommodative squint with convergence excess" in which she touched on the possibility that the syndrome might often be due to weakness of a superior oblique muscle. She became our first honorary orthoptic member, and our good friend. Eighteen years later she read in this journal an account of sagittalisation of the superior oblique muscle, in cases of acquired palsy. Five years later again she has returned with a paper here published, to tell us of recent successful use of this operation in Birmingham, on the type of case she described to us long ago, and which she was the first to interpret.

This little story tells, in a roundabout way, why we seek to widen our horizons, why we rejoiced to welcome the council members of the International Orthoptic Association to our conference of 1980, and why we are happy to publish their papers in this journal.

Another horizon, not geographical but metaphorical, has also been extended. Appropriately in this International Year of Disabled Persons, papers from home and abroad tell us of rewarding work for orthoptists in improving or assessing the sight of handicapped people. Some of the equipment is sophisticated, some very simple. Adaptability, empathy, and patience, essential to all orthoptists, are perhaps needed most of all by workers in this field.

Diana Craig

Miss Emmie Russell presents Miss Sandra Tait (left), winner of "The Emmie Russell Prize" for 1980, with her award watched by the President, Miss Mary Carter (right), at the 37th Annual Scientific Conference of the Orthoptic Association of Australia, Sydney, October 1980.

ORTHOPTIC ASSOCIATION OF AUSTRALIA
37th ANNUAL CONGRESS
SYDNEY
OCTOBER 1980

Presidential Address

The Honourable, Mr. Kevin Stewart, N.S.W. Minister of Health, Dr. Geoffrey Harley, President of the Royal Australian College of Ophthalmologists, and Patron of the Orthoptic Association of Australia, Dr. W. E. Gillies, Secretary of the Orthoptic Board of Australia, Miss Mirelle Loully, President, Miss Barbara Lee, Secretary-General and Miss Mary Wesson, Treasurer of the International Orthoptic Association, distinguished guests, fellow members.

I would like to welcome you all to the opening of the Orthoptic Association of Australia's 37th Annual Conference.

Mr. Minister, we are indeed pleased to have you join us to-day, in what appears to be becoming an annual event. As one of the smaller para-medical groups, we, orthoptists recognise the honour you have given us in performing our opening ceremony.

Dr. Harley, you have interrupted a busy schedule en-route to the Royal Australian College of Ophthalmologists and Ophthalmic Society of New Zealand Conjoint Congress in Christchurch. We extend our good wishes for a successful meeting.

It was with pride that I heard Miss Loully announce in Berne last year, that the 1980 Meeting of the Council of Management of the International Orthoptic Association would be held in Sydney, Australia. Our Association is a founder and full member of the International Orthoptic Association and we are privileged to have the Association's Annual General Meeting held for the first time in the Southern Hemisphere. A number of us have attended the conferences in London, Amsterdam, Boston and Berne, and look forward to visiting Cannes in 1983. We have been ably represented on the Council of Management by Patricia Lance and Shayne Brown, and on the Permanent Scientific Committee by Anne-Marie Mahoney and Patricia Lance.

Members recognise the importance and necessity of interchange of ideas and techniques with their international colleagues.

With this in mind, our Association, in 1978, held its Annual Conference in Singapore. This was the first para-medical "off-shore" conference in the Republic of Singapore. The conference took as its theme, "The Eyes of Three Cultures". Guest speakers included ophthalmologists, orthoptists and members of the medical profession from Singapore, Argentina, United Kingdom and Australia. We ourselves have reciprocity of qualifications with Great Britain. This international interchange of qualifications is also recognised by Canada and France, the United States of America and Canada.

Some of our members have worked overseas in countries including the United Kingdom, Canada, Italy and Nepal.

In Australia, with our large migrant population, orthoptists are conscious of the need to assist with the eye care of different ethnic groups, and have adapted their methods to cope with non-English speaking patients. Some of our members, with the advantage of at least a second language are called upon to act as interpreters in various clinical situations.

The orthoptic training schools in New South Wales and Victoria have accepted overseas students from various Asian countries, to train in Australia. Many of these will return to their own countries to practise their chosen profession.

Our I.O.A. representative Shayne Brown, our able conference convenor Jeanette Yap, and the organising committee have arranged a stimulating scientific programme and a social programme in which I hope you will all enjoy meeting your international and Australian colleagues informally.

In the October 1979 issue of "Conference" an article on "Rules of Planning the Right Meeting" defines a conference as "usually general sessions and face-to-face groups with a high participation to plan, get facts, solve organisation and member problems". If we can achieve a little of this during our time together in Sydney, we may well feel we have achieved some success.

Mary Carter, D.O.B.A.
President, Orthoptic Association
of Australia, 1979-1980

PATRON'S ADDRESS TO THE ORTHOPTIC ASSOCIATION OF AUSTRALIA – OCTOBER 1980

Madam President, Mr. Minister, Distinguished Guests and Members of the Orthoptic Association of Australia.

When you did me the honour of inviting me to be your Patron for this year I was indeed quite excited. I expected this to be the first year in which we would hold a close, combined meeting of the College and the Association with many of the orthoptists attending as Associate Members of the College.

It is a personal disappointment for me that this has not come about; but I fully understand that your commitments to the International Meeting and your overseas guests would not allow you to continue to accommodate to the uncertainties and rapid changes which took place in the Christchurch arrangements.

Be that as it may; we will certainly welcome those of you and those other orthoptists who may not be here today, who will be coming on to New Zealand. We certainly hope that arrangements will be better for the Queensland Meeting in 1981 – as good as they were for the Neuro-Ophthalmology Symposium held in Brisbane earlier this year.

Some sixty years ago when Mary Maddox played a big part in the foundation of British Orthoptics there was certainly a place for an ophthalmologist in a paternal role. In her case it was her own father.

I wonder now, what is the paternal role of the ophthalmologists towards the orthoptists – if any.

I am quite sure that you have come so far in your educational achievements and professional development, that the continued appointment of an ophthalmologist as a Patron might be anachronistic.

There is still real advantage for you remaining allied to the medical profession, in spite of the many ills that beset our profession and the multiple factors which tend to lower our professional morale.

We have been forced into ill-conceived health schemes by governments against our advice; then made the scapegoats for the failure of these schemes, with incessant doctor bashing in the media.

There is always something feeding fuel into these media attacks and the farce of the drawn out proceedings of the N.S.W. Prices Commission in this State is a prime example.

Combating these and many other threats tend to occupy intellect and energy and detract from the real job of the profession in getting on with medical practice and teaching the art. Despite all this, as long as our basic principles hold, I am sure medicine will win out in the long run.

Others who would challenge it by the development of alternative health care systems, either base their appeal on cultism rather than on scientific methods or have some scientific training and offer advice with the provision of remedies or appliances. For their support they rely on those who rightly or wrongly are disillusioned by the discredited medical profession and its scientific methods; those who in desperation seek alternative help when scientific methods have failed; those who by manipulation of the law have been directed their way; and those who by advertisement have been led to believe that they are offered a service which is comparable, or superior, to that offered by the medical profession. Perhaps they expect to gain true professional status in this way.

Those who practice in medicine traditionally shed all these devices many years ago, and I hope current threats will not tempt them to lower the professional standards which have served them so well.

Orthoptists, like ophthalmologists, have nothing to sell except their time and skill. They don't sell goods, they don't advertise, they don't tout for business. I am confident that if together we continue in this fashion we need fear no challenge in the long term.

The other area where you may need a little paternalistic help from the ophthalmologist is to protect you from those within our profession who do not fully understand your role.

It is over twenty years now, since I did my resident training at the Royal Victorian Eye and Ear Hospital. During that period, I remember well that I did over 120 squint operations. In those days, we had a peculiar system of training in our final year – one resident would be in outpatients, one looking after the wards for pre and post-operative care of patients, and the third one doing all the surgery. Thus, I would arrive at the hospital and find a large surgical list of squint operation patients completely unknown to me, booked for certain muscle operations, and never to be seen again. In those training days, all squints looked

dull and routine, orthoptists looked old, and orthoptic reports seemed quite incomprehensible.

It was only after a long period in private practice and in public hospitals, with the experience gained from prolonged care of patients that I came to appreciate the consequences, good or bad, of my intervention in their management, whether it was surgical or otherwise.

Recently, Dr. Graham Pittar wrote an article which was widely distributed. It appeared to be a direct frontal attack on orthoptics and orthoptists. I tackled him about this and we had a long and frank discussion. I really believe that he was trying to draw attention to the deficiencies in our own training which I have just mentioned. These persisted for some time after that. We also had our concept of the role of the orthoptist as we saw her at that time.

Hopefully, our modern Fellows graduating in ophthalmology will have a much better understanding of ocular motility problems and visual development and, hopefully, they will not have a concept of the orthoptist's role which is twenty years out of date.

The role of the orthoptist has rapidly changed over the last few years and has been the subject of several addresses by Patrons and Presidents. There is no need for me to labour specific points again. I would at this stage warn however, against a change of identity, to call orthoptists something else, whatever term might be dreamed up.

I think the ophthalmologist of 1980 is different perhaps from the ophthalmologist of 1960, but seeks still to be known as an ophthalmologist. I would stress that there are good reasons for you to continue to be known as orthoptists and retain your identity within the ophthalmic community, at the same time realising that others recognise your changing role.

All one has to do is to draw attention to the breadth and depth of your scientific programme planned for the next few days. This, itself, bears testimony to this change and your contribution to the ophthalmic community and its scientific basis.

Finally, I wish you all well for a happy and successful conference.

Geoffrey Harley, F.R.A.C.O.

Australian Orthoptic Journal,
1980-81, Vol. 18

ORTHOPTIC ROLE WITH THE HANDICAPPED IN BRAZIL

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When I talk about the orthoptic role with the handicapped in Brazil, it is necessary to tell you something about my country so that you can appreciate the enormous challenge we face.

Few people in the world are aware of Brazil's tremendous size. Comparatively, its area is somewhat greater than that of Australia, and somewhat smaller than that of the United States, which makes it the fifth largest country in the world. The population is around 120 million inhabitants. I come from Sao Paulo, the biggest industrial centre of Latin America, where one tenth of Brazil's population is concentrated. There are not enough ophthalmologists to care for the population adequately and, of course, there are even fewer orthoptists (about 300 in the whole country, of whom 80% work in Sao Paulo).

Except for a few patients with eye problems who are referred to private or public orthoptic clinics, Brazilian orthoptists have no contact with the handicapped. This indicates not only that we have not yet earned a place on multidisciplinary teams, but also that medical professionals do not give due importance to vision as a global concept.

It is only since 1972 that the Brazilian Association of Orthoptists has begun to promote the profession. The first step was to participate in preschool screening surveys in public and private schools; the second step was to sponsor scientific meetings for professionals in rehabilitation; the third step was to make sure that the Association is always represented at ophthalmological, paramedical groups, public Health and Educational meetings; the fourth step was to make contact with rehabilitation centres.

In 1977, a group of orthoptists (Miss Nogueira, Miss Ferreira, Miss Muller and Mrs. Lapa) studied one hundred crippled children at one of our largest rehabilitation centres. The Associcao de Assistencia da Crianca Defeituosa (The Crippled Children's Rehabilitation Centre) was founded in August, 1950. At that time, rehabilitation services and even the concept of rehabilitation were practically non-existent in Brazil. This centre may today be considered as the largest and most complete service of this kind in Latin America. There are at least 220 people working there on the staff, including doctors, technicians, nurses, teachers and assistants in the various departments, but there is not one ophthalmologist and, of course, no orthoptist.

Of the hundred patients studied, we could obtain definite findings from seventy nine. Of these, 85% showed some disturbance in ocular motility, 61% had defective vision. The results did show a positive and significant correlation between cerebral palsy and strabismus (76%), ametropia was detected in 96%, significant refractive errors in 55%, and severe ocular anomalies in 16%. Prematurity and anoxia were associated in 56% of the 71 cerebral palsy patients.

As a result of the survey, the rehabilitation centre has for the past two years been referring its patients to the department of ophthalmology and orthoptics at one of our local medical schools. Now, in November, an orthoptic service will be opened and Miss A. Ferreira will be the first orthoptist invited to work at a rehabilitation centre.

It is obvious that we are just beginning to assume our place in multidisciplinary team work, and it will take some years yet for us to report on our experience with the handicapped. Also this year, for the first time an orthoptist (Miss L. Marques) was invited to work at a medical school, in its newly-created department of low vision.

Now I will say something about my personal experience in a small rehabilitation centre where I

was invited to talk about orthoptics. The group of multidisciplinary personnel showed great interest, asked many questions and, during the following weeks, invited me to evaluate the eye problems of some patients – a case of nystagmus, a boy with right hypertropia, and so on.

This experience clearly showed me that the first obstacle we must overcome is lack of information about our profession and about vision in general.

This is one of the reasons why, in my opinion, the main role of the orthoptist should be to educate. Orthoptists have been too much concerned with the technical part of treatment and have given too little attention to teaching professionals in other areas the importance vision plays. It seems especially important, also, that students in general and medical students in particular be made aware of vision as a physical, mental, and emotional function.

Australian Orthoptic Journal,
1980-81, Vol. 18

THE ORTHOPTIC ROLE IN HEAD INJURIES

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Abstract
Seven case reports demonstrate some of the problems which arise in the correct diagnosis, prognosis and treatment of head and facial injury patients with ocular involvements. The orthoptist's role is twofold, aiding the patient therapeutically and the whole medical team diagnostically.

Key Words
Head injuries, nerve palsy, loss of fusion, diplopia, Fresnel prisms, torsion, Hess.

The role of the orthoptist in the care of patients with head injuries is firstly diagnostic, assessing the effect of the injury on the oculomotor system, and secondly therapeutic, relieving the patient's symptoms, restoring his confidence and helping him to return to some useful activity.

Head injuries can affect both ocular movement and binocular vision. Defective ocular movement can result from infranuclear palsies affecting the VIth, IVth and IIIrd cranial nerves; much more rarely it can be caused by supranuclear lesions or by convergence palsy. Binocular vision can be affected by decompensation of a heterophoria, by loss of fusion in some very severe injuries, or by disruption of suppression in an old squint.

The main symptom is almost always diplopia but the treatment and the medico-legal implications are so different that the differential diagnosis of the cause of the diplopia is all-important.

DIAGNOSTIC PROBLEMS

In severe head injuries the picture is often confused by bilateral or multiple nerve involvement, by facial injuries causing orbital fractures, by damage to the globe, and, of course, by the patient's general condition. The following case reports are examples of the problems which can arise:

Case 1

A man aged 20 years was referred to the eye department 10 days after striking his head against a wall in a road accident. The left pupil was dilated and a third nerve palsy was therefore suspected. A temporal field loss was found and there was insuperable diplopia. The Hess chart (Fig. 1) confirmed a bilateral superior oblique weakness. The patient's diplopia was mainly torsional. Bilateral IVth nerve palsies due to avulsion of the nerve rootlets are not uncommon in injuries of this type, making spontaneous recovery unlikely.

Case 2

A girl aged 18 years had sustained left IIIrd, Vth, VIth and VIIth nerve palsies 4 months previously. She also had a left Horner's syndrome. There had been some spontaneous improvement but ocular movement was still limited. It was noted that the left eye was red and proptosed and further examination revealed a bruit due to a carotico-cavernous fistula. Ligation of the common carotid resulted in immediate improvement and there is now only residual diplopia on extreme abduction.

Cases in which head and facial injuries are combined present special problems. If the limitation of ocular movement is caused by an orbital fracture early treatment may be indicated but if it is due to an infranuclear palsy then time must be allowed for spontaneous improvement. Examples of this problem are seen in the following cases.

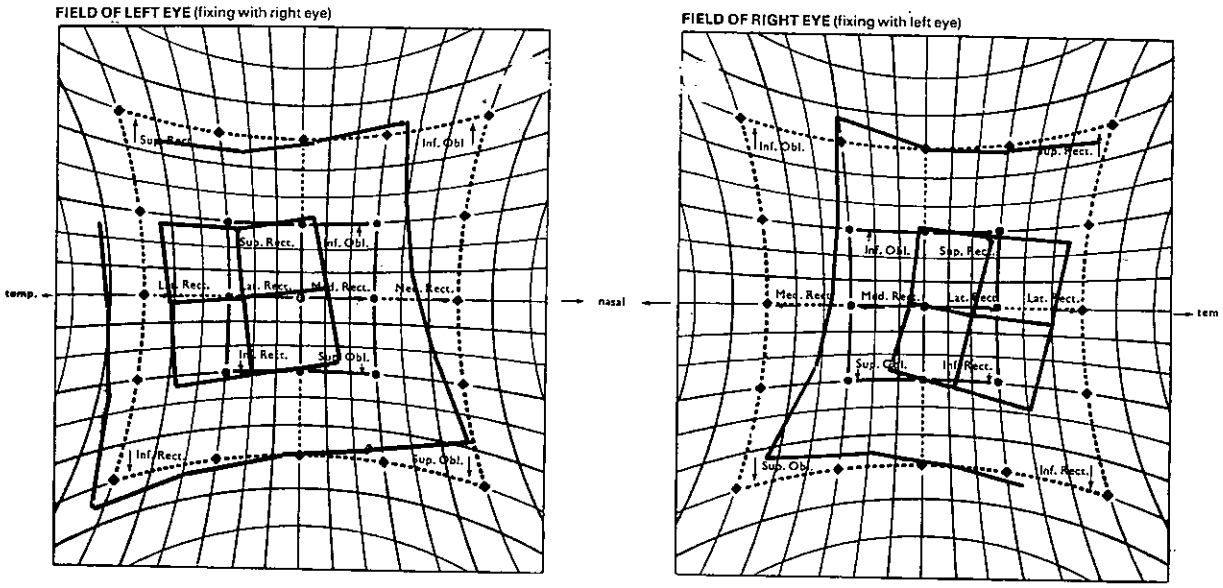


FIGURE 1
J. D. 27.9.79
Hess chart plotted 10 days after head injury showing bilateral superior oblique weakness (Case 1)

Case 3

This patient, a man of 26 years, was first seen a few days after sustaining a very severe head injury. He presented with constant vertical diplopia, a left optic atrophy, which reduced his visual acuity to 6/12, a fractured left maxilla and a complete VIIth nerve palsy. As can be seen from the Hess chart, (Fig. 2) it was impossible to explain his diplopia by a clear-cut underaction of any ocular muscle. There was no torsional displacement of the images. There was no enophthalmos nor retraction of the globe on testing ocular movement. The patient was kept under observation and the orbital fracture was not treated. The diplopia remained unchanged in spite of good vertical ocular movement. Fresnel prisms were prescribed. Spontaneous recovery of the diplopia took place 12 weeks after the injury and there has been slower recovery of the facial palsy. In retrospect it is possible this patient had a skew deviation. He reported that his diplopia resolved suddenly, it was apparently unchanged on waking and fused with the prisms. Later the same day he noticed reversed diplopia with the prisms, and could fuse the images without them. We have several times seen patients who report this sudden resolution of their diplopia.

Case 4

An elderly man presented with what appeared to be a typical superior oblique palsy but he had sustained several facial lacerations from windscreen glass, including a deep right upper lid cut which extended nasally to the trochlear region. It was therefore questioned whether there was a trochlear injury or a IVth nerve palsy. There has been no change in the four months which have elapsed since the onset. The patient has been observed for signs of a developing pseudo-Brown's syndrome but these have not become apparent and a traction test has not confirmed a mechanical limitation of movement. The patient is currently using vertical Fresnel prisms to see if he can overcome the torsional displacement of the images.

THERAPEUTIC PROBLEMS

Loss of fusion following severe head trauma or a bad whip-lash injury is a rare diagnosis. Apparent inability to fuse can be due to other factors such as visual field loss, especially bi-temporal hemianopia, insuperable torsion, a grossly incomitant deviation or simply a long-standing loss of binocular single vision (BSV). An example of this is seen in:

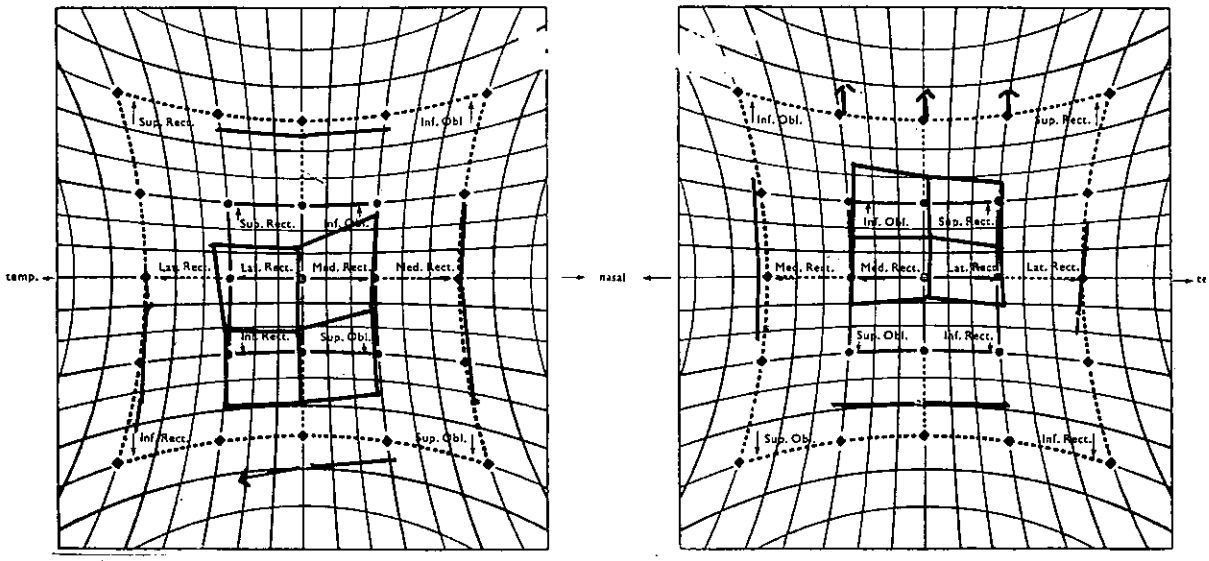


FIGURE 2
M. B. 29.4.80
Hess chart plotted 4 weeks after head injury showing vertical deviation not attributable to specific ocular muscle underaction. (Case 3)

Case 5

This patient is a 57 year old doctor in general practice, had sustained a head injury at 18 years and remembered experiencing vertical diplopia at that time but claimed that it had resolved without treatment. At 53 years he developed a cataract in one eye which was treated by lens extraction and a contact lens. He then complained of almost constant vertical and torsional diplopia due to a marked unilateral superior oblique palsy. His symptoms disappeared when he developed a cataract in the other eye but recurred when he was wearing contact lenses for bilateral aphakia. It proved impossible to demonstrate fusion: even using a synoptophore with the torsion corrected the patient stated that the images were never more than "nearly together". Because of a torticollis, and his conviction that he had had BSV, an inferior oblique myectomy was performed and the patient was sent home with vertical prisms to compensate a residual hypertropia. One month later BSV was present without prisms.

We believe it is essential to restore BSV whenever possible and therefore make much use of Fresnel prisms, keeping a supply of plano spectacles for emmetropes. Overcoming diplopia gives the patient confidence and helps him to cope with his other disabilities; it is also beneficial to the other therapists concerned with his rehabilitation. The individual's attitude to his injury and to prisms varies considerably and the orthoptist can do much to inspire him to make the most of even a small area of BSV.

Recovery of ocular movement in head injury cases is apparently unrelated to the severity of the trauma, some of the most intractable cases are those with relatively minor closed head injuries, as illustrated by the following case.

Case 6

A man aged 50 years slipped on ice and struck his head; he did not lose consciousness and did not visit his doctor until he developed diplopia next day, when a superior oblique palsy was diagnosed. (Fig. 3a). Not only did the superior oblique palsy fail to recover over the next few months, but he developed an unexplained underaction of the eye on elevation (Fig 3b). There was no facial injury and X rays of the skull and orbits were normal. The palsy and the apparent inferior oblique underaction started to improve 6 months after the injury and recovery of movement was virtually full.

Six months is generally accepted as the period which should be allowed for recovery and before performing muscle surgery. In cases of complete paralysis it is tempting for the surgeon to operate sooner, even in the absence of electromyographic

evidence of denervation, since increasing contracture of the ipsilateral antagonist of the affected muscle will occur. The right rime for surgical intervention is debatable.

Case 7

A lorry driver sustained a bilateral VIth nerve paralysis in a road accident. There was partial recovery of abduction on one side but none on the other. The patient had a large angle esotropia, the most affected eye was occluded and he was unable to work. He was seen at an inter-hospital case conference and a Jensen's operation on the paralysed lateral rectus was suggested but due to an administrative delay he was not admitted until 16 months after the injury. Ocular movements were unchanged 2 months before admission but on admission it

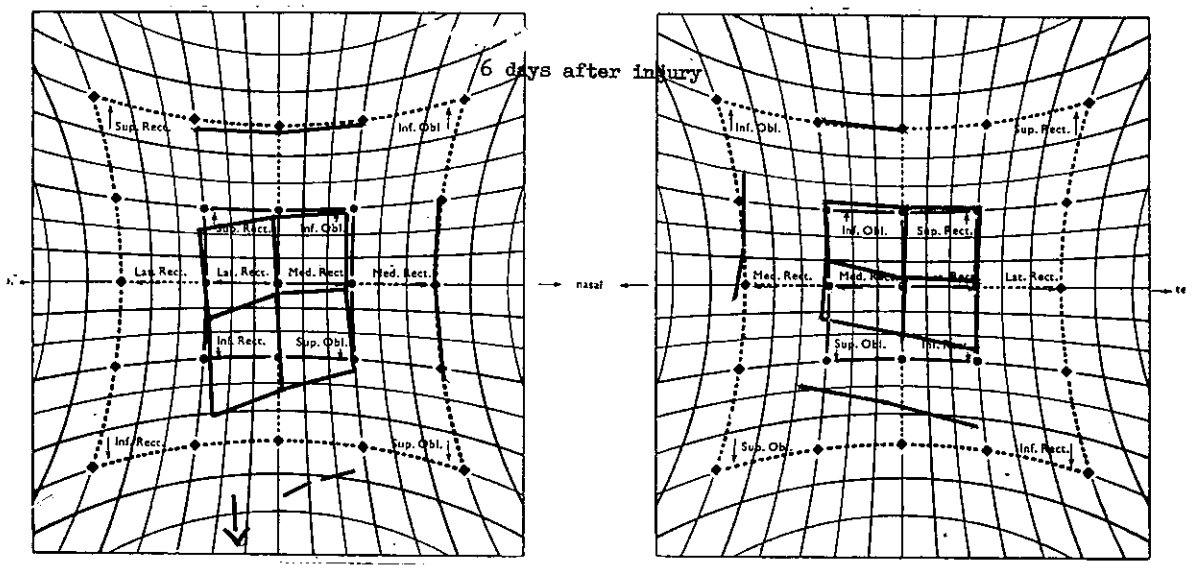
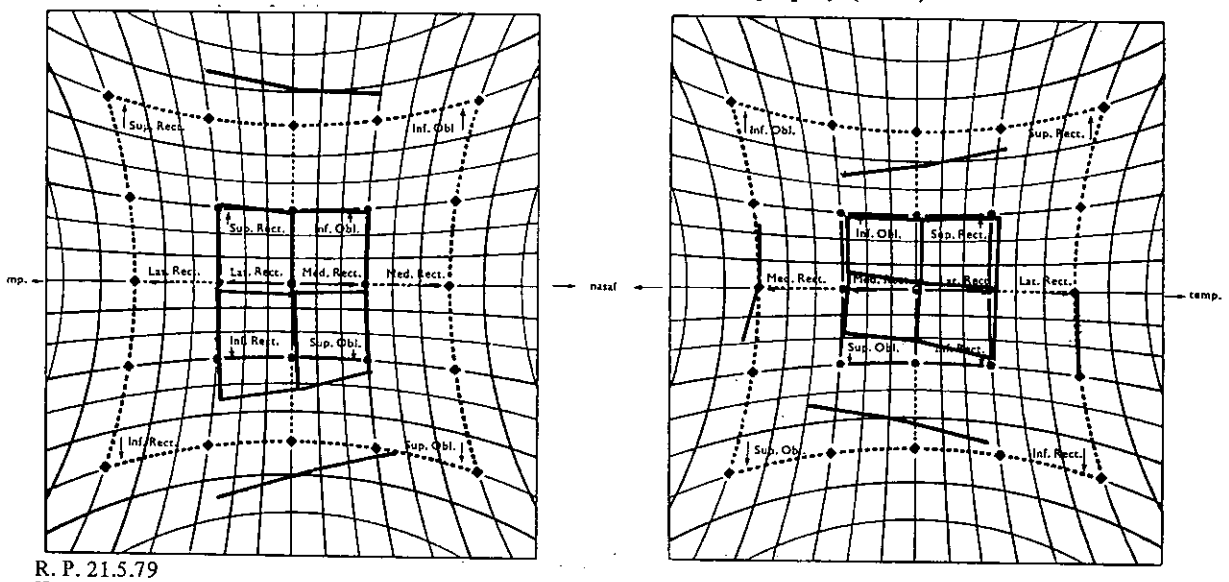


FIGURE 3a
R. P. 6.2.79
Hess chart plotted 6 days after minor head injury showing right superior oblique palsy. (Case 6)



R. P. 21.5.79
Hess chart plotted 3½ months after injury showing development of apparent ipsilateral inferior oblique weakness. (Case 6)

was found that the paralysed eye could abduct 10° past the mid-line. The patient became aware of the improvement in abduction 4 weeks earlier. Conventional squint surgery was performed in two stages and BSV was restored sufficiently for him to return to lorry driving.

This case is an extreme but not unique example of delayed recovery of movement, perhaps suggesting that 6 months is too short a waiting time but against this must be weighed the demoralising effect of unemployment and the fear of losing a job.

In summary, the orthoptist can be of service not only to the patient with a head injury but also the whole medical team, including the ophthalmologist, neurosurgeon, neurologist and members of the other paramedical professions. The orthoptic findings and careful records can aid diagnosis and lead to effective therapy.

DIPLOPIA AND THE CANCER PATIENT

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Abstract
Twenty patients with known systemic cancer and diplopia are discussed. These cases divide evenly between lateral rectus palsy and vertical deviations; the latter presenting diagnostic difficulties. Prism therapy was used. No correlation was found between ocular muscle defect and the type of cancer treatment.

Key Words
Cancer, ocular muscle palsy, prism therapy, radiotherapy, chemotherapy.

This study was supported in part by grants to the FIGHT FOR SIGHT Children's Eye Clinic of Presbyterian Hospital by FIGHT FOR SIGHT, Inc., New York City, New York.

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INTRODUCTION

In the past few years we have noted with increasing frequency patients with systemic cancer presenting with diplopia. We were interested in correlating this occurrence with the status of their cancer, the type of therapy received or any particular etiologic factor.

MATERIALS

We reviewed the charts of 20 patients with known cancer who presented with diplopia. Eliminated from the study were patients with primary brain or orbital tumors. Only two patients had other unrelated systemic diseases. These were hypertension and hypothyroidism.

A. CANCER

In nine patients the primary lesion was breast carcinoma. Cancer of the breast is the most common malignant tumor in women in the United States causing about 20% of all cancer deaths in females. [1] Seven patients had the primary lesion in the head and neck region. Nasopharyngeal carcinoma dominated this group, although tumors of the nasopharynx comprise less than 1% of all cancers in the United States. The average age of occurrence is about 50 years. It is found twice as often in males as in females. Cranial nerve involvement occurs in 38% of these cases. [1] The remaining patients in the head and neck group had cancer of the tongue, gum or larnyx. Three patients had cancer of the prostate and one 18 year old male, the youngest of the group, had diffuse histiocytic lymphoma. The ages of the patients when first seen by us for diplopia ranged from 18 to 79 years. They were evenly divided between male and female. There are 10 known deaths.

B. STRABISMUS

1. Esotropia

Ten patients presented with esotropia. Lateral rectus palsy accounted for the esotropia in all but one of the patients. Five patients with esotropia had breast carcinoma. One, age 79, demonstrated a concomitant, intermittent, divergence insufficiency type of esotropia. By history it had been present but asymptomatic for 10 years. Within the last year it had become worse and for the first time she sought medical advice about it. The

strabismus was felt to be unrelated to the breast carcinoma which had been surgically treated 4 years earlier with no evidence of metastases. A long history of hypertension was questioned as a contributing factor to her strabismic problem. The other 4 patients with breat carcinoma had a lateral rectus palsy. There was no follow on for one patient. The other 3 had bone metastases and two had multiple site metastases. None had clear evidence of brain involvement. All three died within 2 years of the onset of diplopia.

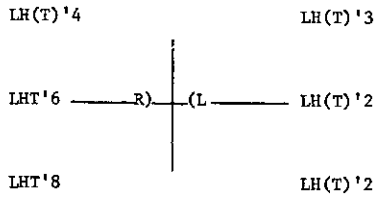
Diplopia was the presenting sign of the cancer in two patients who were diagnosed as carcinoma of the nasopharynx. In one patient the diplopia persisted after effective radiation therapy to the tumor. The second patient was found to have involvement of cranial nerves V through XII. Following radiation he showed evidence of complete regression of the primary tumor with considerable improvement of the multiple cranial nerve palsies. Diplopia persisted. Nine months later the other lateral rectus became involved and there was evidence of recurrent cancer. Brain metastases were found. Death occurred 5 months later. There was no follow on for the patient with tongue cancer. The two patients with prostate carcinoma showed no evidence of metastatic disease. The lateral rectus palsy recovered in one patient while the outcome of the second was unknown.

Esotropia treatment

We successfully treated the diplopia with prisms in 8 patients. One patient did not require a prism. Instead, a head position was adopted for the mild paresis and the patient was comfortable. The lateral rectus palsy recovered in 5 patients. However, one of these patients with metastastic breast carcinoma had a recurrence of the diplopia two years later. She again presented with a lateral rectus palsy of the same eye. One patient came to strabismus surgery without follow-up observation.

2. Hypertropia

Ten patients presented with vertical deviations. Four had breast carcinoma. One of these had a definite diagnosis of a bilateral IVth nerve involvement. The classical picture of right hypertropia in the left field of gaze with left hypertropia in the right field of gaze along with a mild V pattern was easily demonstrated. This patient whose primary lesion was breast carcinoma had diffuse brain and bone metastases. She died 1 month after the onset of diplopia. The other 3 patients with breast carcinoma all had bone metastases. Two showed brain involvement. A left hypertropia was present in these 3 patients. The test results varied making a definitive diagnosis difficult. An example of this diagnostic dilemma is illustrated in the following case. A 49 year old woman, while under chemotherapy for metastatic breat carcinoma, presented with diplopia for a duration of 3 days (Fig 1). She showed a mild left ptosis and a left hyperdeviation in the primary position, increasing to the right field and down. A left superior oblique was suspected; however, neither the head tilt test nor the Lees screen confirmed this diagnosis. In fact, the Lees screen indicated the involvement was with the right eye (Fig 2). The other patients demonstrated similar diagnostic problems.



HTT: R: LH(T) 2
L: LH(T) 3

FIGURE 1

Four of the 10 patients belonged to the head and neck group. All of them again displayed vertical patterns that gave us difficulty in making a definitive diagnosis while employing the usual tests.

Of particular interest were the two patients with nasopharyngeal carcinoma (Fig 3). They both showed a vertical deviation of opposite type in the upper field compared with the lower field of gaze with no restriction of movement. The diagnosis of a partial IIIrd nerve palsy was suggested but not confirmed. Evidence of metastases was not available in one patient. The other had local extension of the tumor but no evidence of brain metastases.

The patient with prostate cancer had a one week history of diplopia from a right hyperdeviation in primary position. A definitive diagnosis was not made and the strabismus resolved within six weeks. No metastases was evident.

The patient with lymphoma, the youngest in our group, developed diplopia from a left hypertropia. Characteristics of a left superior oblique palsy were present but this diagnosis was withheld

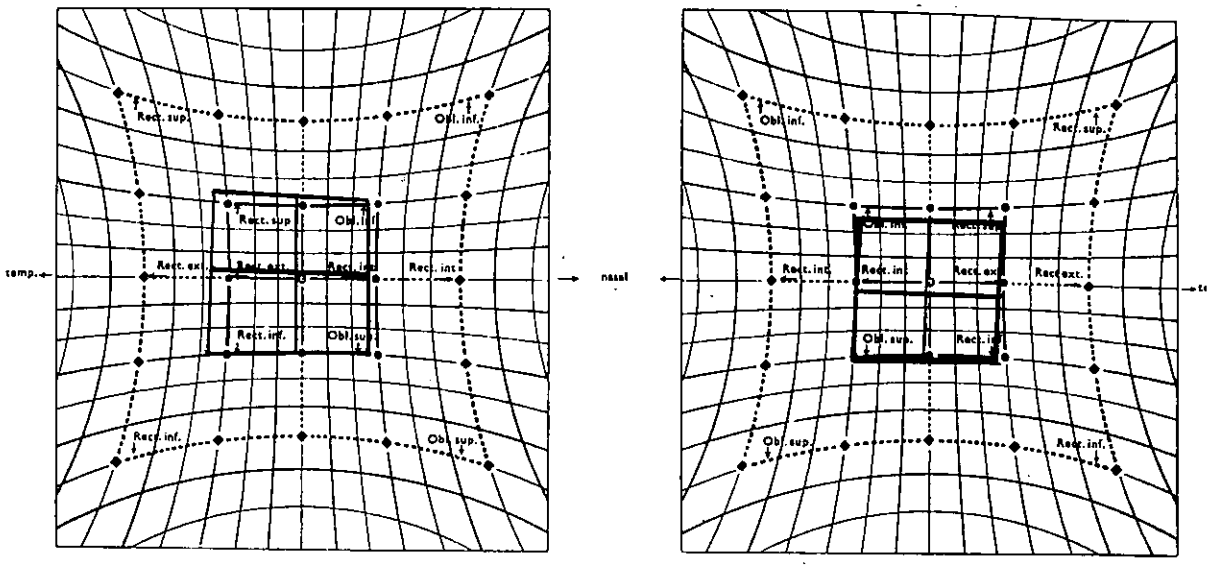


FIGURE 2

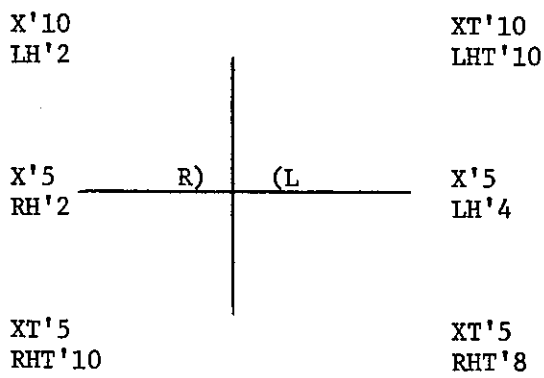


FIGURE 3

because all test results were not supportive. Brain metastases was found and the patient died 3 months after the onset of diplopia.

Considering the difficulty in diagnosing a definite vertical muscle involvement in these cases, we suspect that some of them might well be skew deviations.

Hypertropia treatment

Prism therapy for vertical diplopia was undertaken with 5 patients, two were comfortable while the other 3 patients complained of torsion. Four patients did not receive prisms either due to the seriousness of their condition or because they were not bothered by the diplopia. One patient came to strabismus surgery twice without success.

C. CANCER THERAPY

1. Chemotherapy

Chemotherapy is one of the well recognized non-metastatic causes of neurological dysfunction in patients with systemic cancer. [2, 3, 4, 5, 6] Of the chemotherapeutic agents, there are a few that are especially well known to cause such disorders (Fig 4). These include the vinca alkaloids, the nitrogen mustards and methotrexate. The effect can vary from peripheral neuropathy to cerebellar ataxia to depression. Diplopia is not listed as one of the manifestations except isolated instances with procarbazine. [4] One patient in our series was treated with this drug.

Eleven patients were treated with some form of chemotherapy during the course of their disease. The time sequence of the diplopia in relation to the chemotherapy varied. Onset of diplopia occurred in some patients before chemotherapy was begun, while others after it was completed. In 2 patients diplopia resolved during the treatment.

2. Radiotherapy

Radiotherapy is one of the principle forms of treatment in cancer patients. Nasopharyngeal carcinoma is usually not surgically attacked particularly after symptomatic cranial nerve involvement is present. Therefore radiation is the therapy of choice in these patients. A complication of radiation to this area is lenticular opacities which

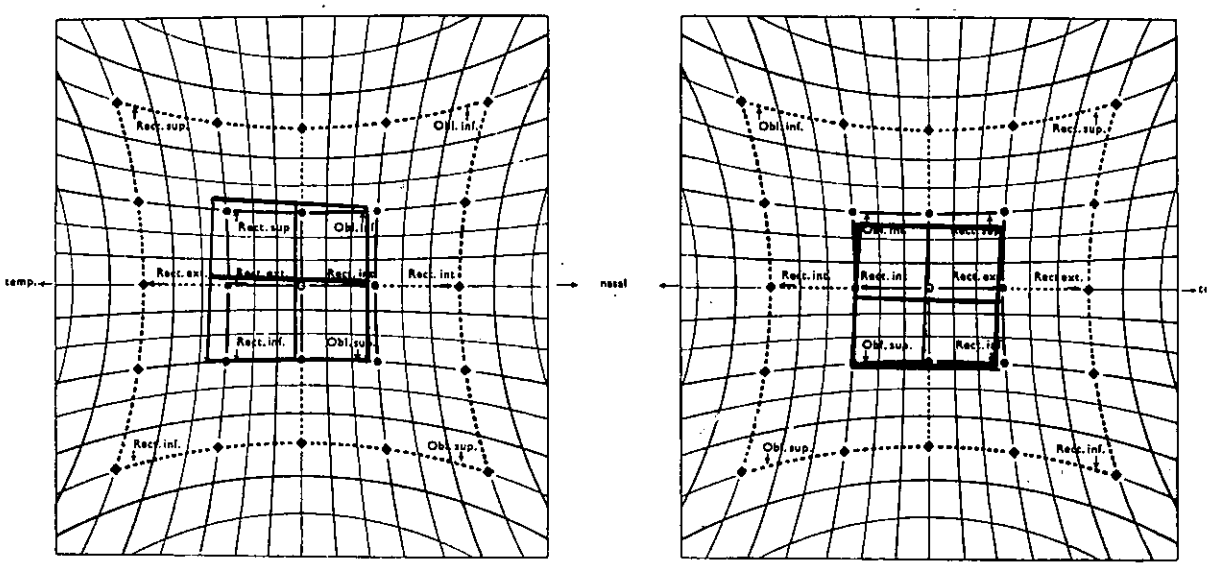
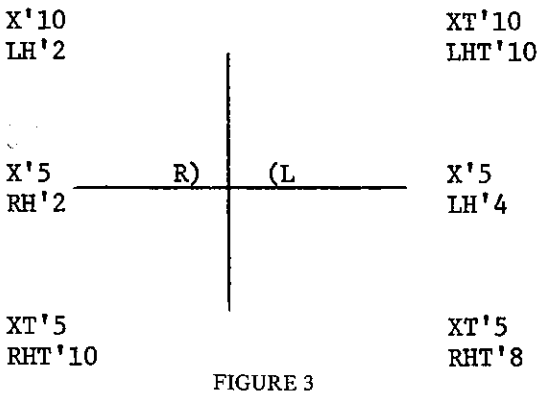


FIGURE 2



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CHEMOTHERAPEUTIC AGENTS CAUSING NEUROLOGIC DYSFUNCTION

VINCA ALKALOIDS
  Vincristine sulfate
  Vinblastine sulfate
L-ASPARAGINASE
NITROGEN MUSTARDS
METHOTREXATE
5-FLUOROURACIL
PROCARBAZINE HYDROCHLORIDE
CYTOSINE ARABINOSIDE
MITOMYCIN

FIGURE 4

are often stationary and subclinical[1] although to some degree preventable by shielding. Various forms of neurological dysfunction following radiotherapy have been reported[5] including delayed radionecrosis of the optic chiasm.[7]

Twelve patients were treated with radiation. No correlation was found between onset of diplopia and the course of radiotherapy. It would appear from this that the onset of diplopia is probably unrelated to either chemotherapy or to radiation.

SUMMARY

In summary, twenty patients with known systemic cancer and diplopia were evaluated. Dominating this group was breast carcinoma followed by nasopharyngeal carcinoma.

One-half of the patients presented with esotropia which was easily diagnosed as a lateral rectus palsy. The remaining patients presented with hypertropias the cause of which could not be easily determined. Every effort was made to relieve the diplopia with prism therapy. Patients with esotropia responded more favourable than did patients with vertical deviations.

From this study we have tried to relate the diplopia found in patients with known systemic cancer to their disease or its treatment. We were unable to find a relationship between the strabismus and the cancer treatment. In patients with end-stage cancer, the strabismus often appeared related to the disease process.

TABLE I

20 CANCER PATIENTS PRESENTING WITH DIPLOPIA

		AGE SEEN	STRABISMUS	PRIMARY CANCER SITE	METASTASES
1.	DLeS	77	RLR	TONGUE-GUM	NONE
2.	IS	67	LLR - recovered	NASOPHARYNX	NONE
3.*	MC	61	RLR - bilateral	NASOPHARYNX	CRANIAL NERVE V TO XII, LOCAL BONE INVASTION, BRAIN
4.*	ES	54	RLR - recovered recurred	BREAST	LOCAL BONE INVASION
5.	MD	62	LLR	BREAST	UNKNOWN
6.*	LD	30	LLR - recovered	BREAST	BONE, PAROTID, OVARIES AND FALLOPIAN TUBES, LUNG
7.*	AS	48	LLR - recovered	BREAST	BONE, SPINAL CORD, LUNG, PALATE AND PHARYNX
8.	HB	79	DI	BREAST	NONE
9.	RG	61	LLR	PROSTATE	UNKNOWN
10.	MK	73	LLR - recovered	PROSTATE	NONE
11.*	RA	61	RHT	NASOPHARYNX	UNKNOWN
12.*	MM	51	LHT - recovered recurred	NASOPHARYNX	LOCAL INVASION LIVER
13.*	BO	63	RHT	LARNYX	UNKNOWN
14.	MB	67	LHT	TONGUE	UNKNOWN
15.	MS	70	LHT	BREAST	LOCAL BONE INVASION
16.*	WW	52	LHT	BREAST	LOCAL BONE INVASION BRAIN
17.	FB	49	LHT	BREAST	BONE BRAIN
18.*	RO	49	BILATERAL IV	BREAST	BONE BRAIN
19.	BW	65	RHT - recovered	PROSTATE	NONE
20.*	WD	18	LHT	LYMPHOMA	BONE LIVER BRAIN

* DECEASED

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AMBLYOPIA AND DISORDERS OF OCULAR MOTILITY IN CRANIOSYNOSTOSIS

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Abstract
In a further study of 39 cases of craniosynostosis, the timing of the Tessier procedure and of the squint surgery are discussed with reference to the incidence of amblyopia and optic atrophy. The effects of the Tessier procedure on the horizontal deviation and particularly on the vertical deviation and the levator function are also discussed.

Key Words
Craniosynostosis, Tessier procedure, amblyopia, optic atrophy, squint, ptosis, hypermetropia.

The term craniosynostosis is applied to a group of conditions in early childhood in which one or more of the cranial sutures fuse prematurely. As the brain expands compensatory growth occurs across the uninvolved sutures leading to various skull deformities. This compensatory growth may be insufficient to prevent a rise in intracranial pressure which is liable to lead to papilloedema, optic atrophy and bony changes around the orbit. The cribiform plate is displaced downwards by the raised intracranial pressure so that the orbital roof becomes more vertical and this leads to a shallowness of the orbits and a relative proptosis of the globes. This is enhanced when the maxilla is underdeveloped, as in Crouzon's disease and in Apert's syndrome. Hypertelorism is produced by an expansion of the ethmoids in temporal directions[1].

These concepts dictate a policy of advising early neurosurgical decompression in all cases of craniosynostosis which show signs of a raised intracranial pressure in order to try and prevent the development of optic atrophy and to limit the progress of secondary bony changes. The deformities of the craniosynostoses contribute to the lack of the development of binocular function and to the occurrence of abnormal ocular movements in many cases, but they may be ameliorated by the major craniofacial procedures described by Tessier[2,3]. If this operation is performed sufficiently early with subsequent squint surgery when appropriate, there should be a chance of achieving the development of some form of binocular function even if this is of an anomalous type, but in many cases this is an unrealistic ideal, as discussed later.

The purpose of this study is to establish the incidence of amblyopia in children with craniosynostosis and to what extent the amblyopia might have been prevented by early craniofacial and squint surgery, and also to assess the results of surgical treatment. The general features of the craniosynostoses have been discussed in a previous communication[4].

OPTIC ATROPHY AND AMBLYOPIA

This paper is concerned with 39 children who have been assessed at the Hospital for Sick Children, Great Ormond Street, over the past 3 years; 15 of the 39 cases were subjected to the Tessier procedure. 10 cases had optic atrophy with a corrected visual acuity which varied between 6/12 and perception of light, and 7 cases had amblyopia without optic atrophy so that in these cases the defective vision was simply the result of a squint, but amblyopia can also occur in the presence of optic atrophy so that the defect in the vision is exaggerated by the amblyopia.

The intercanthal distance in the cases showing amblyopia varied between 34 mm. and 60 mm., but there were only 3 cases in which the intercanthal distances were asymmetrical with the amblyopic eye on the side with the greater.

displacement. It follows that an asymmetrical intercanthal distance is only a minor factor in the development of the amblyopia, with other precipitating factors such as a refractive error (particularly astigmatism or anisometropia) or a partial degree of optic atrophy, as more important factors, quite apart from some form of squint which causes a strabismic amblyopia.

STRABISMUS

Strabismus was found in all but 4 of the 39 cases, and in general terms there is a greater preponderance of an exodeviation in hypertelorism, a greater preponderance of an esodeviation in Apert's syndrome, and a more or less equal occurrence of exodeviation and esodeviation in Crouzon's disease (Fig. 1). In all the 35 cases showing squint, there was an associated V phenomenon with an overaction of the inferior obliques which is a characteristic feature of the V phenomenon.

	NAD	ESO	ESO + vertical	EXO	EXO + vertical	vertical
Crouzons		4		3		
Crouzons + Hypertelorism				1		
Aperts		7	1	1		1
Aperts + Hypertelorism					1	
Hypertelorism	3	2		8		
Plagiocephaly + Hypertelorism	1		4		2	

1 case = unilateral complete tarsorrhaphy

Figure 1. Nature of squint in this series of craniosynostosis.

REFRACTIVE ERRORS

30 cases in the series had a significant refractive error of 2 dioptres or more of hypermetropia or myopia, or of one dioptre or more of astigmatism in one or both eyes; the astigmatism of the less good eye varied between ±0.75 and ±5.00 dioptres. The increased incidence of hypermetopia and hypermetropic astigmatism in this series (Fig. 2) is possibly associated with the shallowness of the orbit, which is a characteristic feature of craniosynostosis.

REFRACTIVE ERRORS

Hypermetropia				10
Myopia				2
Astigmatism	– Hypermetropic		14	18
	Myopic		2	
	Mixed		1	
	Myopic one eye	Hypermetropic one eye	1	

Figure 2. Types of refractive errors in this series of craniosynostosis.

RESULTS OF CRANIOFACIAL SURGERY ON STRABISMUS

15 of the 39 cases had craniofacial surgery (the Tessier procedure) and 14 of these cases had an associated squint. In 7 cases of Crouzon's disease or Apert's syndrome the frontal bone and the maxilla were advanced with a reduction in the proptosis. The craniofacial surgery increased the inferior oblique overactions from a vertical point of view by up to 20 prism dioptres, but reduced the torsional influence of the muscles. In 8 cases of hypertelorism the craniofacial surgery caused a reduction in the hypertelorism with the persistence of a divergent squint in only 3 cases, and otherwise with the development of a convergent squint in a case with a previous exotropia or with an increase in the esotropia which was present before the craniofacial surgery (Fig. 3).

Pre-Operative Deviation	Post-Operative Deviation	Number of Cases
NAD	ESO	1
EXO	ESO	2
EXO	EXO	3
ESO	increased ESO	2

Figure 3. Influence of craniofacial operation on squint in hypertelorism.

RESULTS OF CRANIOFACIAL SURGERY ON PTOSIS

Ptosis may be present in some cases preoperatively, but when it develops post-operatively it may be the result of post-operative oedema, a disinsertion of the aponeurosis of the levator tendon, a retroposition of the globe, a loss of support of Whitnall's ligament (the superior transverse ligament) due to a mobilisation of the periosteum, or damage to the tendon or its nerve supply. It is evident, however, that although 75% of cases after craniofacial surgery show some degree of ptosis (as measured by the opening of the palpebral apertures), there is only a relatively slight degree of levator weakness when a detailed assessment is made of the levator function of the upper eyelid so that an actual involvement of the levator tendon or its nerve supply is relatively rare.

RESULTS OF SQUINT SURGERY

Squint surgery was carried out in 11 cases, including 7 cases following craniofacial surgery. The results show that only one case achieved a normal form of binocular function, with only a latent type of deviation. In the other cases there was a small residual horizontal deviation accom-

panied sometimes by a small residual vertical deviation, and in some cases 2 or even more operations were necessary to achieve a satisfactory cosmetic result. A small residual deviation, however, is consistent with the achievement of some form of anomalous peripheral fusion.

DISCUSSION

Only 24% of the patients in this series had optic atrophy so that theoretically it should have been possible to prevent defective vision in the other cases provided craniofacial and squint surgery were carried out sufficiently early. There is, however, a disadvantage in early surgical treatment of the squint because there tends to be a greater degree of relapse than when the surgical treatment is carried out in the older child. This is a contradiction to the usual management of a squint in childhood, when early surgical treatment enhances the possibilities of achieving a binocular result (even although this may be of an anomalous type), provided appropriate measures have been adopted pre-operatively to deal with any amblyopia of the squinting eye and also with any anomaly of retinal fixation. This difference in approach is related largely to the change in the character of the squint which follows craniofacial surgery, particularly when there is a significant increase in the vertical deviation. This tends to occur because an advancement of the frontal bone alters the position of the trochlea with a consequent change in the action of the superior oblique (Fig. 4), and an advancement of the maxillary bone alters the origin of the inferior oblique with a consequent change in its action in a similar way. These changes in the actions of the oblique muscles consist of a reduction in their torsional actions but with an increase in their vertical actions because of a change in the directions of the lines of pull. It must be assumed that the increase in the effectiveness of the vertical actions of the oblique muscles is greater for the inferior obliques than the superior obliques to account for the persistence of the V phenomenon, perhaps because an alteration in the action of each superior oblique in the region of the trochlea is a more or less inevitable outcome of the Tessier procedure[5].

The role of the superior obliques in the production of the V phenomenon in the craniosynostoses is defined more clearly in cases which have not been subjected to the Tessier procedure. For example, in hypertelorism there is a displacement laterally of each orbit, and this causes a decrease in

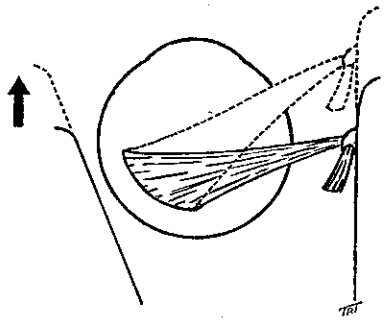

Figure 4. Change in action of superior oblique after craniofacial surgery.

the effectiveness of each superior oblique as a depressor of the eye because of an increase in the angle of pull of the muscle with the vertical meridian[5] (Fig. 5).

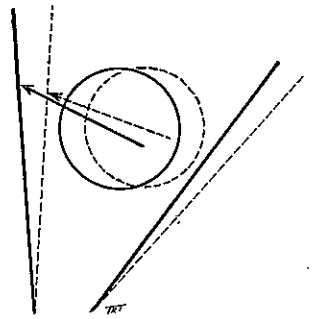

Figure 5. Change in line of pull of superior oblique in hypertelorism.
Continuous line represents orbit after lateral displacement and abnormal line of pull. (Drawing by Mr T. T. Tarrant, Institute of Ophthalmology)

A different view has been expressed[6] with an overaction of the inferior obliques as the primary event in the V phenomenon in oxycephaly and Crouzon's disease. This follows the shallowness of the orbit in an anteroposterior direction which results in a diminished role of the inferior transverse ligament of Lockwood (suspensory ligament) in supporting the eyeball so that there is an enhancement of the action of the inferior oblique and inferior rectus muscles which are closely associated with the inferior transverse ligament and which attempt to compensate for the diminished action of the ligament.

A further view has been put forward which suggests that the overaction of the inferior obliques in the V phenomenon in craniosynostosis is the result essentially of some form of muscular dystrophy[7], but this would appear to be a limited explanation in the majority of cases.

It is evident that there is some uncertainty about the cause of the oblique muscle imbalance which is a characteristic feature in craniosynostosis before and after craniofacial surgery. It is also evident that it is difficult to correct this imbalance by squint surgery, and this is complicated further by the change in position of the eyes which follows craniofacial surgery with an alteration in the horizontal deviation (a decrease in an exotropia or an increase in an esotropia), and an increase in the vertical deviation.

In general terms the management of such cases should consist of an early correction of any refractive error by spectacle lenses, the relief of amblyopia as far as possible by occlusion, and a delay in craniofacial and squint surgery until it is considered that the most appropriate time has been reached to achieve the best overall result.

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FOURTEEN PATIENTS WITH BILATERAL SUPERIOR OBLIQUE DEFECT AND CONVERGENCE EXCESS CORRECTED BY SAGITTALIZATION

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Abstract
The nomenclature of this type of strabismus is mentioned. An indication of the age of onset and incidence is given. Reactions to the loss of superior oblique muscle function are stated. Factors common to all patients as well as the orthoptic investigations, orthoptic treatment and explanation of surgery to the patient's parents, are given. Surgical results and change of symptoms are noted.

Key Words
Superior oblique, convergence excess, esotropia, bilateral, sagittalization.

Introduction

A procedure used by Professor F. Hollows to correct traumatic superior oblique palsy has been described by Jeanette Yap [1]. This procedure was used by Mr T. Roper-Hall in Birmingham to correct superior oblique defects in fourteen children, whose cases are presented here.

In each case, the surgical procedure was bilateral and done in two stages. Firstly, the superior oblique was split from its insertion to, or almost to the trochlea, the lateral portion being detached and inserted under the resected lateral rectus. One month later, bimedial rectus recession was made, to correct remaining convergence.

This method was chosen because it was felt that weakening a sound muscle, ie, the inferior oblique, was not physiologically sound as it did not influence the deviation where it was most troublesome.

It is hoped that this report will be useful as the condition is by no means uncommon and to date conventional treatment has not been satisfactory.

Classification

The condition under discussion has been known by a variety of names – constant esotropia with accommodative element, intermitten esotropia with convergence excess (from 1947 onwards), or most commonly, convergence excess [2].

Whatever the name given to this deviation, there are variations. It may be unilateral or alternating; it may vary in degree for near vision depending on the level at which the fixation target is held and the clarity of vision required by the viewer.

It is commonly agreed that this type of deviation is demonstrable under the age of three years. When decompensation takes place before this age, it is likely that the deviation will be present for near and distance viewing, because of the lack of strong binocular functions and the ease with which suppression is invoked.

Investigation

Lloyd [3] gave 80% of children under the age of ten years as having a vertical component for the cause of their angle of deviation. In the same year Wesson [4] attributed 38% of 369 squinting patients to a superior oblique malfunction.

If one considers the main action of the superior oblique muscle, it is apparent that the deviation will be greatest on depression and for near viewing, for if the patient is tested looking down for distance, the deviation is almost always present.

A defect of the superior oblique muscle may show one of several characteristics and can also be

affected by other factors such as refractive error, facial structure and the desire for binocular single vision. The most likely variations are as follows:

1. Paralysis – congenital or acquired.
2. Definite weakness of all functions of the muscle.
3. Malfunction due to a) misalignment of the muscle, b) adhesions, c) displacement from the trochlea.

The patients in this study were considered to have misalignment of the muscle because binocular testing showed defective depression on adduction, whereas on uniocular testing the defective movement was less obvious.

The likely results of malfunction of the superior oblique muscle are:

1. Intermittent manifest convergence for near.
2. Intermittent manifest convergence, greater for near than for distance.
3. Constant manifest convergence, greater for near than for distance.
4. Control of the deviation by loss of accommodation, (usually with older patients).

All fourteen patients were in groups 1 – 3.

Common Factors

1. Convergent deviation greater for near than distance.
2. 'V' phenomenon.
3. Defective depression on adduction.
4. Updrift of the adducted eye in the uniocular field, some showing this in the binocular field as well.
5. Abnormal head posture, greater for near and after testing.
6. Dislike of looking down.
7. Fixation with the more affected eye as far as could be assessed.
8. Insecure, fidgety children.
9. Central fixation on visuoscopic examination.
10. General health good.

There were however a number of widespread general problems such as dislike of close work and of going down stairs, irritability and poor co-ordination, intermittent diplopia, asthma and insecurity, the latter especially in the younger children.

Examination: ophthalmic

Ocular examination revealed normal fundi in every case. Four patients were hypermetropic, two of these having astigmatism and receiving optical correction. There was no one precipitating factor, and in most cases, none was known. Photographic evidence showed in each case that an abnormal head posture was present from early infancy.

Examination: orthoptic

Histories revealed onset, intermittent at first, between the ages of twelve months and seven years. Family histories gave two patients with similarly affected sibs, and there were three with relatives who had coloboma. All the patients had greater convergence for near than for distance. Only four were controlled for distance, and only one controlled above the midline for near. Twelve had convergence with hypertropia in the primary position, the other two showing hypertropia in adduction only.

All the fourteen had updrift and defective depression of the adducted eye, "V" phenomenon, and dislike of testing in depression. Nine showed downdrift of the abducted eye. In no patient was stereoscopic vision demonstrable. In all cases synoptophore measurements showed increased torsion on depression. Each of the older patients was tested on the Lees screen.

Treatment

All patients were given glasses where applicable and occlusion to equalise visual acuity, to achieve diplopia, and to achieve alternation. Before operation, parents were told that the surgery was in two parts, the first to correct torsional and vertical deviation; the eyes would not look better after the first operation though the head should be erect. The second operation was to correct the horizontal deviation.

Plano spectacles where necessary were supplied to allow use of Fresnel prisms after the first operation.

Post-Surgical Findings

Following the second operation it was expected that binocular single vision for near and distance, without an abnormal head posture, would be present. Examination showed:

9 out of 14 had demonstrable binocular single vision, 2 had doubtful binocular single vision, 3 had no demonstrable binocular single vision.

Thirteen out of the 14 patients attained a normal head posture and all were symptom-free. The parents remarked that generally the children were more confident, better-tempered and experienced fewer problems with close work than previously.

Conclusion

This surgical procedure has shown, in the fourteen cases examined, a considerably improved success rate when compared to other procedures as it corrects the deviation in the area where it is most troublesome.

Acknowledgement

My thanks to Mr T. Roper-Hall FRCS for his co-operation with this paper and to Professor F. Hollows for his support.

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A METHOD OF VISION TESTING OF SEVERELY HANDICAPPED CHILDREN

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Key Words
Vision testing, handicapped children

Six symbols from the first communication board used by handicapped children at the Waverley Special School (Victoria) were chosen and presented in varying sizes (6/60 – 6/9) in the manner of single Sheridan Gardiner optotypes. The identification board was large enough to be rested across the arms of a wheel chair, the symbols on it being well separated to facilitate pointing with finger or headpointer.

63 of the 64 handicapped children tested were able to respond to these familiar objects and thus an estimate of their visual acuity was possible. This failure rate of less than 2% is compared with 16% failure on the conventional tests by the same group of multiple handicapped children. The method is simple, quick and successful.

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RETRAINING OF CENTRAL FIXATION IN THE PARTIALLY BLIND DUE TO DEMYELINATING DISEASES OR OTHER ORGANIC LESIONS

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Abstract
Methods of visual retraining are described for patients suffering loss of central vision and impairment of spatial orientation due to a demyelinating disease.

Key Words
Multiple sclerosis, demyelinating disease, visual retraining, spatial reorientation.

Demyelinating diseases such as multiple sclerosis can cause various symptoms involving the eyes. One is ocular deviation causing diplopia, which is treated with prisms in all our orthoptic centres. One orthoptic school does more than this. MS can also cause loss of central vision, a loss which not only affects the reading ability of the patient, but also impairs his orientation in space. Thus the patient is severely handicapped in addition to other symptoms caused by MS. For more than 15 years Professor Otto and his orthoptists in St. Gallen have been treating patients with loss of central vision due to organic lesions. Their methods are described in various publications[1,2] and have been adopted in several countries. I would like to outline the main points in this systematic training course.

Therapy has to be carried out as if there were no damage to the macula. The exercises have to be as realistic as possible so that the patient realizes that he can actually see better in daily life through use of the tiny islands in the macula which retain some vision.

1. Exercises with the aid of the sense of touch

The aim is to direct the eye accurately in every visual meridian. Indirect gaze (a sort of eccentric viewing) gives way to central fixation, and separation difficulties grow less when smaller targets are used.

Firstly the palm of the examiner's hand must be localised correctly with the periphery of the retina, at a distance of 25 to 30 cm. the patient is asked to cover the hand of the examiner with his own in all visual directions with increasing speed and without searching movements.

Then the examiner forms a ring with his thumb and forefinger. The patient is told to fixate the middle of this ring and then to pierce it with his forefinger without touching the ring. The examiner constantly watches the patient's eye, and may have to demand immediate action the moment the eye is seen to be correctly adjusted. Central fixation is also challenged when the patient is asked to touch a single small object as quickly as possible, again in constantly changing visual directions, or when he is asked to touch the fingertips of the examiner's hand in changing order. At first the hand is held still, then it is presented with slow sweeping movements. It is all-important that the eye should be directed accurately before touching.

2. Exercises without the sense of touch

Here the patient is asked to achieve central fixation while the object is shown at increasing distances. We use cards 15 cm square, with thin black frames. Each shows a single optotype at the centre, in sizes from 0.1 to 1.5 for 5 metres (5/50 to 5/7.5), the frame of each card making it easier to find the optotype at the centre. Successively smaller optotypes are presented at a distance of 50 cm, so that gradually more central parts of the retina are called for. Then the cards are shown in different directions of gaze.

After a while the examiner moves away in steps of about 25 cm, thus increasing the distance at which optotypes are to be read. The aim is to maintain central adjustment of the eye when more and more of the surroundings crowd into the field of vision. The optotypes are steadily reduced in size. If the patient shows insecurity or loss of central adjustment by moving his head he is at once told to close his eyes, then to look at a bigger area (ceiling, floor, etc.) and then to adjust his eye to the middle of the card while consciously keeping his head motionless. If he fails, the exercise has to start again at 50 cm so that the false localisation will not prevail.

For near vision training, dice of different sizes (height varying from 0.5 cm to 5 cm) and different colours (white, black, blue, and red with black or white spots) are used. The patient picks out the dice he can see best – usually a white one with black spots. After reading the number of spots he is asked to find other numbers of spots on the dice. Through this excerise the patient has another psychologically important experience: as a consequence of the damage to the macula the coloured dice are perceived in various shades of grey. With more and more frequent use of the macula centre, colour perception will return, and this in turn stimulates the patient to know better whether he is using the centre or not.

3. Exercises to train reading ability

The main aim of all the exercises mentioned so far is to recover reading ability. There are two further requirements:

- to recover reading movements in combination with
- discrimination of fine detail.

First sheets are used with horizontal lines of different lengths, at the end of which numbers are printed. With these, following and localising movements are elicited. At first the numbers are rather big, in order to stimulate pursuit movements; gradually the numbers get smaller, requiring differentiation of finer detail. We also use sheets on which numbers are typed with one, two or three digits. A black mask is put over the numbers so that only one at a time is visible in the middle. The hole in the mask is moved evenly over the numbers; the patient has to decipher each one as it appears. Next, he is shown a whole row of numbers, with a black strip of paper above and below. He is told to read the whole row one number after another, and is not allowed to leave any out.

The next step is to children's books with big letters. Again the examiner puts black slips above and below the line to be read and at first frames every word with his fingers so that only one at a time is visible to the patient. It is essential that he should perceive the first letter of the word, not to pass over it. Long words will scare the patient at first, and should be read out to him. It is important that the examiner reads out words that are not recognised as soon as the patient shows any hesitation, so that there will be no stagnation in the reading movement. The print is made smaller and smaller. There also exist sample texts with print which steadily decreases in size.

Even when reading ability is regained it is important to explain to the patient that because of his disease he will be no longer able to take in the face of the text at a glance or to fixate at will any letter with its surroundings, but that he must consciously carry his eye along from one fixated point to the next, unconcerned by the lack of perception to the right and left. It is understandable that the patient can read small type better than big print. Big print will not wholly fit into the remaining islands of the damaged macular area so that searching movements are apt to start, disrupting the physiological central adjustment of the eye.

It may sound very easy to carry out all these exercises. From my own experience with this therapy I can assure you that treating patients with organic lesions is an extremely difficult task. It not only involves tremendous concentration on the patient's eye, but also some psychological skill in encouraging those patients who are disheartened and timorous in spirit because of their disease. However if a patient regains orientation in daily life and perhaps even reading ability, it is certainly worth the effort.

Summary

In patients with loss of central vision due to organic lesions, spatial orientation is impaired as a result of a vicious circle of indistinct vision, eccentric fixation and suppression of foveal perception. By systematic training, the normal sense of direction and thereby good orientation may be restored, and by reactivation of suppressed macular functions some reading ability may be regained. The training course is described on the basis of 15 years' experience.

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Australian Orthoptic Journal, 1980-81, Vol. 18

FURTHER ROLES OF THE ORTHOPTIST IN THE REHABILITATION OF THE PARTIALLY SIGHTED.

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Abstract
The role of the orthoptist at the Royal Blind Society is described, with emphasis given to the vision training programme for those who have lost macular vision.

Key Words
Vision training, visual aids

For the greater part of this year an orthoptist has been working for the Royal Blind Society in three main areas; The Child Development Unit, The Sensory Development Programme and The Low Vision Clinic. The orthoptist's role in the first two of these areas has been previously well described by Pardey and Guy [1] and Wulff [2], so this paper will describe the additional aspect of the orthoptist's role in the Low Vision Clinic.

LOW VISION CLINIC: (L.V.C.)

This is the main area of involvement for the orthoptist at present.

As described by Wulff[2] the L.V.C. provides a vision training programme which is aimed at patients who have lost their central vision, but still have useful peripheral vision.

The paramacular point providing the best visual acuity is established subjectively. The patient is asked to describe the position where he sees a card the clearest as it is moved into different positions (up, down, right and left). As he is doing this he fixates a point straight ahead. The card is the size of a large playing card and is held approximately 33 cms from the eye. The same procedure is then repeated at 3 metres and 6 metres. As the distance increases the patient must turn his eyes off centre, further away from the object but maintaining the same visual angle.

Once this point has been established it must be frequently reinforced to become firmly established. This reinforcing is done at first by the patient at home where he is instructed to use this point for everyday tasks, for example t.v. and meals.

In the clinic, various tasks are performed by the patient such as identifying dominoes of different sizes, playing cards and common street signs, as well as practice with visual aids to ensure that the correct retinal point is being used.

Once paramacular fixation becomes automatic, use of visual aids and the visual functioning of the patient usually improve greatly.

The average number of visits to the clinic is five, with the patient attending weekly or fortnightly.

It should be understood that the aim of vision training is to enable the patient to make better use of his remaining vision. Although most patients show an improvement in visual acuity and improved motility, some patients' measured visual acuity only improves minimally; however the mobility of these patients is markedly improved. The improvement of visual acuity is not always indicative of the patient's improvement in performing everyday tasks.

Recently the orthoptist has also become involved in providing a training session in the use of the visual aids for patients with newly acquired visual aids, as well as providing a home follow-up service.

These two services were provided as it was becoming more obvious that patients were being prescribed aids and, after brief instruction as to the use of the aid, were going home where they were tried once and then put away, and never

tried again. Consequently there were a number of unhappy patients returning to the clinic for further visits and some that did not return at all.

As a result of this, the orthoptist is instructed in the method of use of each visual aid and now after a patient has received his new aid he spends some time before going home learning what that aid can be used for, how to use it, how to arrange correct lighting and generally practising with the aid so he is confident handling it.

Some time later the orthoptist visits the patient's home to ensure that the aid is being used correctly and is satisfactory. As many of the patients are elderly we find that their homes do not have adequate lighting and often that they have forgotten how to use the aid or do not know whether to us it for near or distance tasks, in the house or outside, or both. In these cases a home follow-up is very beneficial.

After this visit a report is made to the other staff members of the L.V.C. and any further needs of the patients are discussed. A further appointment with the L.V.C. is arranged if necessary.

The following examples illustrate some of the benefits gained:–

Mrs. D.S. – Age 77
Macular degeneration and aphakia
Left convergent squint

Initial V.A.	– 5/24 (both eyes open)
	– 3/9 (both eyes open)
	– N4.5 with magnifier
	– N8 without magnifier

Mrs. D.S. is now reading and writing well, watching television, playing cards and seeing the prices at the supermarket.

Mrs. R.L. – Age 72
Macular degeneration

Initial V.A.	– 2/15 (both eyes open)
Final V.A.	– 2/4 (both eyes open)
	– N4.5 with magnifier

Mrs. R.L. now reads, does crosswords and plays scrabble.

Mr. T.C. – Age 65
Chorio – retinal dystrophy with macular degeneration

Initial V.A.	– 3/45 (both eyes open)
Final V.A.	– 3/24 (both eyes open)
	– N12 with magnifier

Mr. T.C. owns his own business and can now manage his own books.

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Australian Orthoptic Journal,
1980-81, Vol. 18

ELECTROPHYSIOLOGY AND THE ORTHOPTIST

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Abstract
Electrophysiological examination of the visual system traces an image from the retina to the visual cortex. By using a combination of tests we are able objectively to establish the integrity of the total visual pathways or to isolate a lesion to a particular area.

Some of these tests are described, i.e. the electroretinogram, electro-oculogram, visually evoked potential and auditory brain stem response and their clinical importance is discussed.

Key Words
Electrophysiology, orthoptist, electroretinogram, electro-oculogram, visually evoked potential, auditory brain stem response.

INTRODUCTION

Any living cell is accompanied by several physico-chemical phenomena of which the electrical is most easily demonstrated. The visual tissues are no exemption to this rule.

The production of electrical activity in the retina obeys the general rules of cell electrophysiology. All living cells including rods and cones possess an electrical charge. This charge is different on each side of the cell membrane. This difference is known as the potential difference. It is due to an imbalance of ions across the membrane, i.e. between the intra-cellular contents (higher K^+ concentration) and extra-cellular fluid (higher Na^+ concentration).

The biophysical characteristics of the cell membrane are changed suddenly by an appropriate stimulus (e.g. light for the photo receptors). This alters the characteristics of the cell membrane separating intra and extra cellular media resulting in an influx of Na^+ and efflux of K^+ with an abrupt alteration of the potential difference – an action potential. This is a very basic explanation for the foundation of electrophysiological responses of vision.

History

Reymond Dubois in 1849 first discovered the resting potential of the eye i.e. the potential difference between the cornea and retina. In 1865 Holmgren noted that a change in this potential was produced by light. In Edinburgh in 1873 Dewar and McKendrick measured this alteration and attempted a human electroretinogram. The method was considered too exhausting and uncertain to permit qualitative or clinical investigation. Further developments occurred as a result of the work by Einthoven and Jolly, 1910, Sach, 1929, and Granits in 1933. But until Rigg in 1941 and Karfe in 1944 produced a contrast lens electrode this investigation remained difficult. Modern electronic and computer development has resulted in a marked increase in activity in this field.

Ocular electrophysiological tests of vision include the following examinations:–

1. Electroretinogram E.R.G.
2. Electro-oculogram E.O.G.
3. Visually evoked cortical potential V.E.P.

Electrophysiological examinations of ocular motility include:–

1. Ocular electromyography
2. Electronystagmography
3. Auditory brain stem response

The E.R.G. (Electroretinogram)

This represents the action potential of the retina. It is produced by a brief stimulus, e.g. a flash of light and is recorded by electrodes placed on or near the eye.

The form of the E.R.G. (Fig. I). The initial response is the A wave – a negative (in our laboratory downward deflection) wave of relatively minor amplitude. This is followed by a positive peak of much larger amplitudes. The final response is the C wave a less well defined positive wave. The responses are altered by the state of light or dark adaptation.

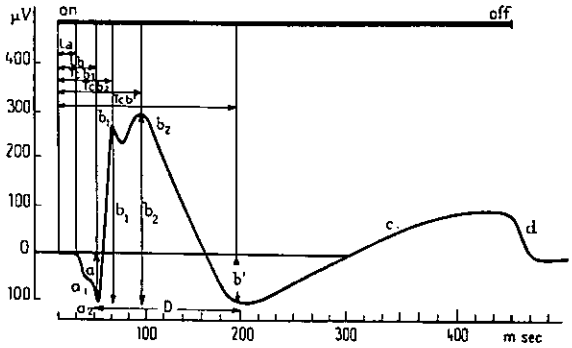

Figure I. Normal E.R.G.

The small oscillations on the surface of the B wave, oscillatory potentials, are a more recently described phenomenon of considerable significance.

The cellular origin of the E.R.G. components is as follows:–

A wave – inner segment of receptor cells
B wave – Muller cells
Oscillatory potentials – Feed back amacrine to bipolar cells
C wave – pigmentary epithelium

Thus the E.R.G. is a function of the outer layers of the retina – pigment epithelial layer of the bipolar cells.

The E.O.G. (Electro-oculogram)

This measures the change in the resting potential of the eye as it passes from dark-adapted to light-adapted phase.

It is a measure of the integrity of the pigment epithelium. The amplitude of this response is normally far greater in the light adapted state than it is in the dark adapted state. The ratio between these two resting potentials expressed as a percentage is known as the Arden Index.

Clinically the value of these two tests is inseparable and in investigation of retinal function usually both tests are required.

Definitive diagnostic assistance is available in:

A. Disorders of choroid
B. Disorders of pigment epithelium
C. Hereditary central retinal dystrophies and degeneration
D. Receptor cell disease
E. Retinal degenerations
F. Retinal intoxications
G. Trauma

The Visually Evoked Potential

This test pursues the electrical activity from the inner layers of the retina (ganglion cell layer) to the cortex i.e. via the optic nerves, chiasm and radiation. Disease or disorder at any area in this pathway can result in disruption of this response. This response can be used as a measure of retino-cortical conduction and because of the large cortical area devoted to fibres from the maculae it represents principally the reception of the central retinal message.

Technique of Measurement of the V.E.P.

Electrodes are placed over the occipital region (positive) and a reference electrode is applied to the vertex. The patient is then placed before a suitable visual stimulator. One of the most commonly used stimuli is a checkerboard which is so arranged that the black and white squares can alternate in position i.e. produce a "pattern-reversal stimulus".

To effectively extract the biological signal from the electrical noise of muscles and other brain activity each stage of signal processing must be as efficient as possible.

The Pre-Amplifier

The electrodes are connected initially through short cables to a pre-amplifier. This is required because biological signals are so minute and easily distorted by ever present electrical interference. Biological signals need to be amplified before interference (noise) can dilute the required signal. The output from the pre-amplifier is connected then to a further device.

The Biological Amplifier

This is an electronic signal processor capable of increasing the amplitude of tiny biological electrical impulses by many thousand times.

Biological signals as low as a micro volt (i.e. one millionth of a volt) can be increased to one volt so that they can be displayed on oscilloscopes, drive XY plotters, or be converted to digital code for computer processing.

The Averager

The signals from the amplifier are fed to an averager (which is usually computer controlled) when they are so small that they cannot be distinguished from the noise. This will "average out" the noise while the signal (being always present) will be additional and will grow, e.g. one thousand samples of a nana volt (10^{-9} volt) will produce a microvolt signal (10^{-6}) with noise virtually absent.

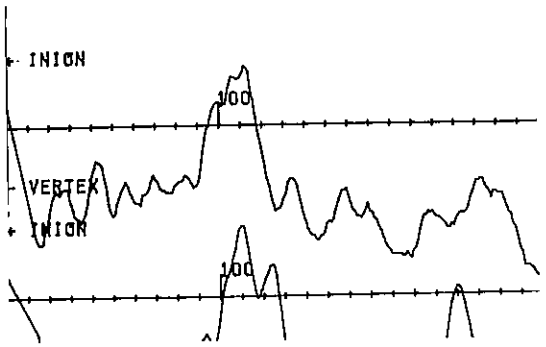

Figure II. The normal V.E.P.

The signal having been collected can then be displayed, measured and printed.

The Normal Visual Evoked Potential

The normal V.E.P. (Figure II) has several wavelets. The fifth or principal wave occurs at 110± 5 milliseconds from the time of the stimulus. It is regarded as normal if it has an amplitude of greater than 7.5 microvolts, i.e. has a magnitude of 7 millionths of a volt and occurs about one tenth of a second after the stimulus.

Disease or disorder of the visual pathway will result in an abnormality of the V.E.P. This can be represented by any of the following:–

a) Decreased amplitude
b) Altered waveform
c) Prolonged latent period
d) Abolished response

The clinical use of the V.E.P. has been the subject of a previous paper[1]. The more common uses are summarised in Table I.

This paper will discuss the use of the V.E.P. in objectively determining vision.

TABLE I
COMMON CLINICAL USES OF THE V.E.P.

A. LESIONS OF THE OPTIC NERVE AND ANTERIOR VISUAL PATHWAYS FREQUENTLY DISPLAY ABNORMAL V.E.P.

1) Demyelinating lesions
2) Compressive lesion of the anterior visual pathways
3) Toxic lesions
4) Ischaemic lesions
5) Optic atrophy

B. ASSESSMENT OF VISUAL ACUITY

1) In infancy or incapacitated patients
2) In hysterical amblyopia
3) Amblyopia

C. VISUAL FIELD ASSESSMENT

Two techniques are available
1) Using a multiple electrode technique
2) Using half or quadrantic field stimulation

D. SCOPE FOR FUTURE DEVELOPMENTS

1) Refraction
2) Disturbance in colour vision
3) Detection of learning disabilities

a) The V.E.P. in Assessment of Visual Acuity

The V.E.P. obtained with a pattern reversal stimulus increases in amplitude with increasing element size until it reaches the modal size of receptive field centres (i.e. subtends an angle of 10′ – 20′). Subsequent increase in stimulating element size results in a decrease in amplitude (Fig. III). With diminished visual acuity maximum amplitude will be seen with a larger stimulus (e.g. 40′).

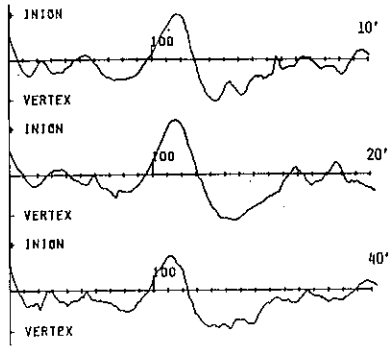

Figure III. V.E.P. with variable size checkerboard stimulus. Largest response occurs with 20′ checkerboard.

Methods of estimation of visual acuity using the V.E.P. has been suggested by a number of authors Sokol[2], Dobson[3], Atkinson[4]. A variety of techniques are described, e.g. graphs of amplitude of response to varying size of stimuli are extrapolated to zero.

b) Refractive Error

The amplitude of response of the V.E.P. will be greatest when the image is in clearest focus on the retina. An objective refraction is therefore possible by varying the corrective lens to obtain the maximal response. If a linear grating is used and this is rotated the axes of astigmatism can be discovered.

c) Amblyopia (Fig. IV)

More simply the amplitude of response can be compared between the two eyes. The amplitude of one subject's eyes will be equal with equal visual acuity. Reduction of one response means reduction of vision in one eye. A definitive diagnosis of reduced vision and therefore amblyopia is thus possible at any age in the absence of pathological or refractive changes. Latent period of the principal peak may be prolonged in the amblyopic eye.

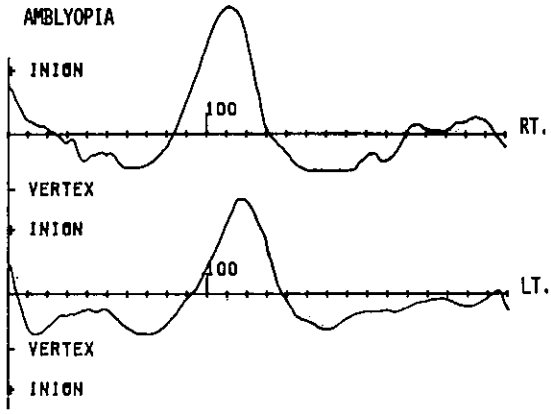

Figure IV. The left V.E.P. is reduced and delayed due to amblyopia.

d) Binocular Vision

Single binocular perception of images falling on the retina may be obtained by neural summation of images or by neural suppression. This can be confirmed electrophysiologically. Under normal viewing conditions virtually the same images fall on corresponding retinal areas i.e. dioptic viewing. This results in neural summation. In disorders of binocular vision the image on each retina differs in terms of sharpness of focus, size, orientation, intensity or correspondence i.e. dichoptic viewing. This results in neural suppression.

Summation of V.E.P. (Fig. V)

In dioptic viewing the binocular V.E.P. is greater than the monocular V.E.P. Summation is greater for sharply focussed patterns than for diffuse lights. If identical patterns are presented dichoptically,binocularly summation occurs, but as presentation of pattern to one eye is varied binocular suppression occurs, increasing with the degree of dissimilarity (Fig. VI).

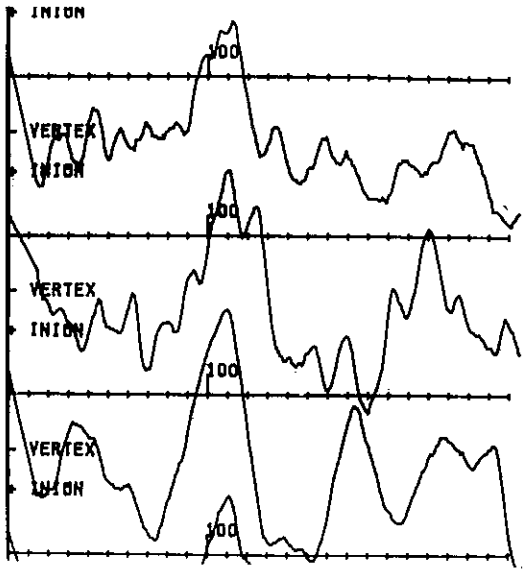

Figure V. Summation of V.E.P. with binocular viewing. The lowest tracing shows the increase in response with binocular vision.

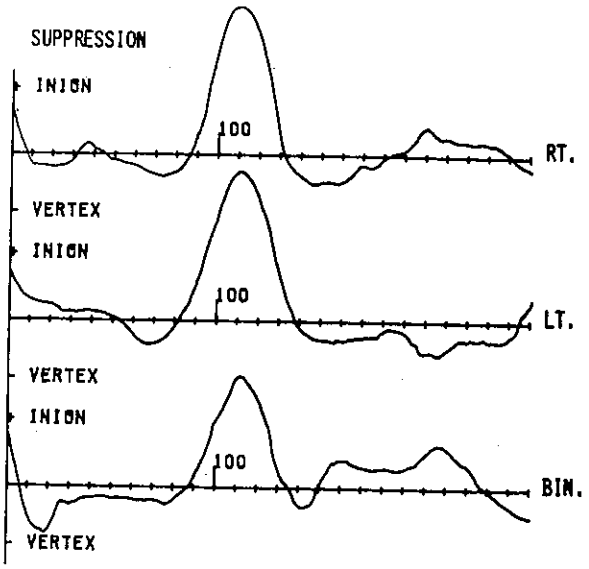

Figure VI. Suppression of V.E.P. with dichoptic stimulation. The lowest response shows a reduction in response with dichoptic stimulation.

The V.E.P. thus enables objective diagnosis of binocularity and even the clinical ability to objectively determine stereo acuity becomes possible with a special stereoscopic stimulating pattern[5].

Having determined the presence or absence of binocularity a further evoked response is becoming increasingly important in investigation of eye movement.

The Auditory Brain Stem Response

This response is one of the most exciting electrophysiological tests for the ophthalmologist and particularly the orthoptist.

The auditory evoked response uses an auditory response to elicit an electrical response from the brain stem. This may be followed to the cortex but unlike the visually evoked potential the anatomocal generator of each of the early waves of this response is known. (Fig. VII)

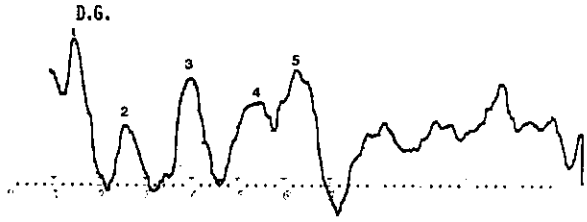

Figure VII. The normal auditory evoked potential origin of Wave I – cochlea
Wave II – cochlear nucleus
Wave III – superior olivary complex
Wave IV – lateral lemniscus
Wave V – inferior colliculus
Wave VI – medial geniculate body

The pathway of the auditory impulse through the brain stem to the inferior colliculus is therefore in close association of the nuclei of the III, IV and VI nerves. Abnormalities of the A.B.R. have been noted in.

1. Duane's syndrome
2. Congenital esotropia
3. Gaze palsies

1. Duane's Syndrome

Hoyt[6] noted an abnormality in the A.B.R. in a moderate number of patients with Duane's Syndrome. This is demonstrated in Fig. VIII.

2. Congenital Esotropia

The neurological aetiology of congential esotropia is usually suspected . Fig. IX displays the A.B.R. from an infant with congenital esotropia. The only evidence of neurological damage in this child was a body tremor. The A.B.R. gives definite evidence of brain stem damage as an aetiological factor.

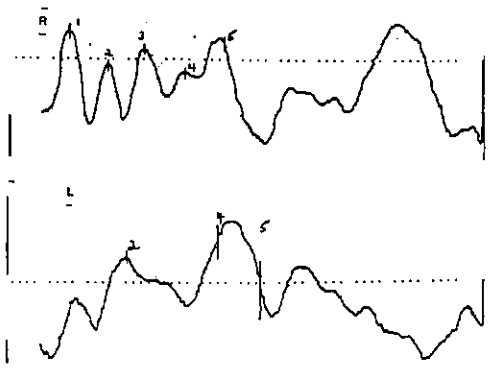

Figure VIII. The A.B.R. in Duane's syndrome shows an abnormal wave III and delayed waves IV & V.

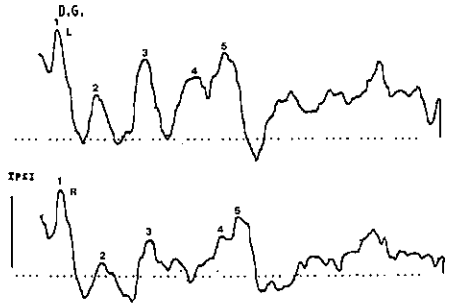

Figure IX. The A.B.R. with a brain stem lesion shows a delayed wave IV & V with decreased amplitude in the right tracing.

3. Gaze Palsies

Review of 20 multiple sclerosis patients who had a history of a gaze palsy showed that 90% had an abnormal A.B.R. This was a much greater percentage than the 60% with abnormalities of the A.B.R. in those multiple sclerosis patient's without a history of a gaze palsy.

Review of patients with a history of gaze palsies of other aetiologies is currently being undertaken.

The auditory evoked response may well become more an ophthalmic than an aural investigation.

CONCLUSION

Electrophysiological investigation is an important clinical part of ophthalmology. In particular visual and auditory evoked responses offer potential for investigation of neuro-ophthalmic disorders and research into function of the visual pathways which were previously unavailable.

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A NEW METHOD OF ELECTROPHYSIOLOGICAL INVESTIGATION OF VISUALLY HANDICAPPED CHILDREN

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Abstract
422 visually handicapped children are studied for etiology, age of onset and level of visual acuity. Electrophysiological studies are being used to try to understand the basis of the amblyopia and further research in this area seems desirable.

Key Words
Visually handicapped, amblyopia, electrophysiology, E.R.G. sclero-corneal contact lens, optical fibres, light pencil.

Two associations – the A.N.P.E.A. and the F.N.A.P.E.D.V. have been set up in France to study the problems of visually handicapped amblyopic children. They aim to help the families of these children by a) representing them at the cabinet level of the Secretary of State for Social Action and b) guiding them through the necessary steps with the C.D.E.S. which in turn evaluates the visual handicap, provides medical and educational guidance and grants an allowance for special education.

Only ten orthoptists are working with low vision patients in France. Their main goal is to maximise the use of the patient's residual vision and to promote some degree of self-sufficiency for them. With favourable familial and social environment, adaptive faculties can be developed.

Working in this context, it is not our purpose to measure precisely the level of visual acuity, but to observe the behavioural approach of the handicapped children and watch how they manage to utilise their remaining visual capabilities. Neither is it necessary to introduce classical orthoptic re-education which has little value in these cases. Orthoptists try to help each child with his particular problem. The aim should be to encourage the child to achieve the best possible level of vision, avoiding any preconceived ideas of what the child might or might not do.

From a recent statistical study of 422 children with visual handicap we would like to present the following results:

1. The age of onset of the visual handicap:

At birth	24.7%
0 – 1	35.1%
1 – 3	18.5%
4 – 6	11.5%
7 – 8	5.1%
9 – 15 yrs	5.1%

Almost 60% of children with low vision show age of onset before the age of one year, and 30% between one year and six years of age. Half of those children with late onset had suffered trauma ie 5%.

Awareness of the visual handicap varies but often it is the parents who notice that their child does not follow objects at the age of three months. At this age initial electrophysiological investigation is possible. The problem then is to decide whether it is a pure visual handicap, an encephalopathy or a psychomotor retardation.

2. The visual acuity:
   Below 0.05 (6/120) 50%
   Between 0.05 – 0.1 (6/60) 25%
   No precise evaluation recorded 25%

No information was requested on the visual field. The assessment of visual acuity is important as this is the only parameter which is used to evaluate the visual handicap for the provision of future medico-educational guidance and qualification for grants for special education.

3. Causes of visual handicap in our 422 children:

At birth	23.7%
Premature	11.4%
Cataract	10.9%
Rubella	8.7%
Retinal diseases	7.8%
Glaucoma	7.6%
Diseases	5.6%
Heredity	5.2%
Injury	4.3%
Myopia	3.6%
Tumor	3.3%
Toxoplasmosis	2.4%
Albinism	1.9%
Nystagmus	0.7%
Unknown	3.5%

Parents are often uncertain of the cause of the child's visual handicap. Hopefully, electrophysiological studies of each case will help to define the cause of the handicap more precisely.

4. Handicaps associated with low vision:

Motor handicap	12%
Hearing problems	7%
Brain dysfunctions	9%
Several handicaps	4%
Without other handicap	68%

5. Early schooling: (only 80% of 422 children).

Normal kindergarten	62%
Specialised kindergarten	38%

87% were already classified as low vision children.

6. Braille education:

70% are learning Braille at school but most of the children wanted to be educated only in "black". They wished to be considered as normal students and to join the normal school courses as soon as possible.

The role of the orthoptist is to help these children with their specific problems which are based on the cognitive processes of visual perception. These children may have poor memory for visual stimuli and have poor concentration.

ELECTROPYSIOLOGICAL INVESTIGATION

In order to understand better the etiology and explain to the parents the visual handicap of their child, we have undertaken the development of a new method of stimulating the retina by means of a light pencil conducted through optical fibres from the light source to the pupil of the patient's eye.

For this purpose, the extremity of the fibre is set in a scleral contact lens laid on the eye. This contact lens also contains a measuring electrode for electroretinograms (E.R.G.) which enables the operator to conduct various investigations (static E.R.G., dynamic E.R.G., measurement of retino-cortical conduction time).

This special lens, originally designed by Mr. Dudragne, has enabled us to obtain excellent results. It is made of soft black plastic and is easy to wear. (See fig. 1)

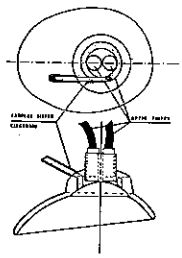

FIGURE 1
Special Sclero-corneal Lens
Produced by ESSILOR (FRANCE)

The manufacture and testing of the prototype have now been completed, and the advantages of the system appear to be the following:

- the recording is not affected by the movepatient's head, eyes or eye-lids:
- the position of the patient does not interfere with the light source which makes the system very convenient;
- the results are linked to a precise stimulating wave-length, determined by the geometrical characteristics of the optical fibre and by the position and the characteristics of the filter set between the source and the fibre.

This visual electrophysiological procedure is objective and does not require co-operation of the subject. It includes an electro-retinogram for retinal function and a study of the visual evoked potentials for macular function, optic nerve, tract and occipital cortex. It is important to realise that E.R.G. can be recorded in new-born babies. The amplitudes are smaller than in average results but the "A" and "B" waves are separated even in the first days of life.

Conclusion

In connection with a recent statistical study of 422 visual handicapped children in France, we

have attempted to introduce the role played by electrophysiological investigation of visual function.

It is essential to make an early decision about the child's near and remote future. The choice of the most suitable medical and cultural orientation will result from better knowledge of the child's psychology, his family and social environment, as well as from a detailed medical investigation.

Thanks to continuous strides in optics, electronics and computing, we hope that in future, we shall have even better tests, allowing more precise and reliable results. Collaboration between ophthalmologists and orthoptists in research should be encouraged in the field of electrophysiology.

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STATIC PERIMETRY — A PSYCHOPHYSICAL TEST

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* *The work being carried out with static perimetry in the Retinal Dystrophy Service clinic at the University of N.S.W. has been made possible through the generous donation of the The Lions' N.S.W. — A.C.T. Save Sight Foundation.*

Abstract
The physical factors contributing to the definition of static perimetry as a psychophysical test are linked to the physiological background and comment is made on their clinical significance. The psychological factors are noted and the value of the test is briefly stated.

Key Words
Static perimetry, psychophysical, physiological, quantitative, threshold, Goldmann, technique.

Perimetry shows the relationship between physical characteristics of the stimulus and the psychological or perceptual response by the subject.

Kinetic perimetry attempts to locate the boundaries of the visual field and the areas within that are sensitive to preselected moving test objects. Static perimetry attempts to find the sensitivity of the retina at preselected locations with stationary objects, thus giving a retinal profile[1] through the mountainous visual island i.e. a vertical section of threshold values along a chosen meridian.

Hecht, Schlaer and Pirenne[2] in 1942 reported an experiment in which they found the lowest intensity of interrupted light flashes that the normal human eye could see i.e. threshold intensity. It is on such early experiments that current methods of testing by static perimetry are based.

PHYSICAL FACTORS AND PHYSIOLOGICAL BASIS

In order to understand the value of static perimetry and realize the need for accuracy in technique a knowledge of the relevant interrelated physical, physiological and psychological factors is necessary. Therefore in the following paragraphs the PHYSICAL and PHYSIOLOGICAL factors involved have been linked and their clinical application noted. The psychological factors are discussed separately.

(1) Luminosity of target and threshold at locations on the retina

The relationship between the sensitivity of the retina to light and the location of the stimulus on the retina is examined in static perimetry. In the normal subject the graph of the sensitivity to light is affected by the distribution of the rods and cones with the influence of the rods increasing as the target moves peripherally. (Compare fig. 1 with photopic graph in fig. 3).

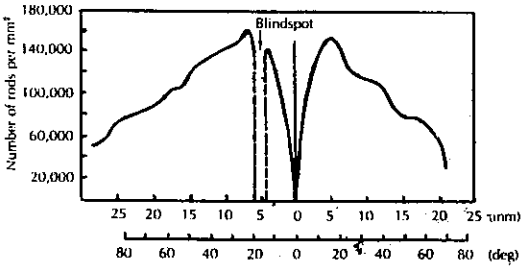

Figure 1. Rod density along horizontal meridian of right eye. (After Pirenne, "Vision and the Eye" (1967) p.32)

Threshold is considered reached when the subject responds 60% of the time.[2] Hecht and his co-workers queried: Why does the subject not respond 100% of the time when the intensity of the target is set at threshold? They concluded this was a consequence of the physics of light itself and that the subjects' judgements are particularly consistent.

The commonly used bracketing or staircase technique is the most accurate for approaching and finding threshold[3] i.e. the target is alternatively presented at supra and sub threshold levels until a mean is reached at which the subject responds at

least 3 out of 5 times to a set target luminosity at one selected location. Errors are smaller with this technique than with "the method of limits" (gradually ascending steps from sub-threshold) although short and long term effects of threshold fluctuations are still present.[4]

The patient is advised as to the approximate location of the target in order to minimise some of the psychological factors to be mentioned.

Local adaptation of the retina is avoided by allowing an interval of at least 2 seconds between the interrupted presentations of the stimuli after there has been an affirmative response.

The number of locations to be tested must be limited by practical considerations, such as fatigue, and one meridian should take no longer than about 15 mins. A suspicious area can be ascertained initially by kinetic perimetry and the required meridian(s) then selected for static testing. (see fig. 2)

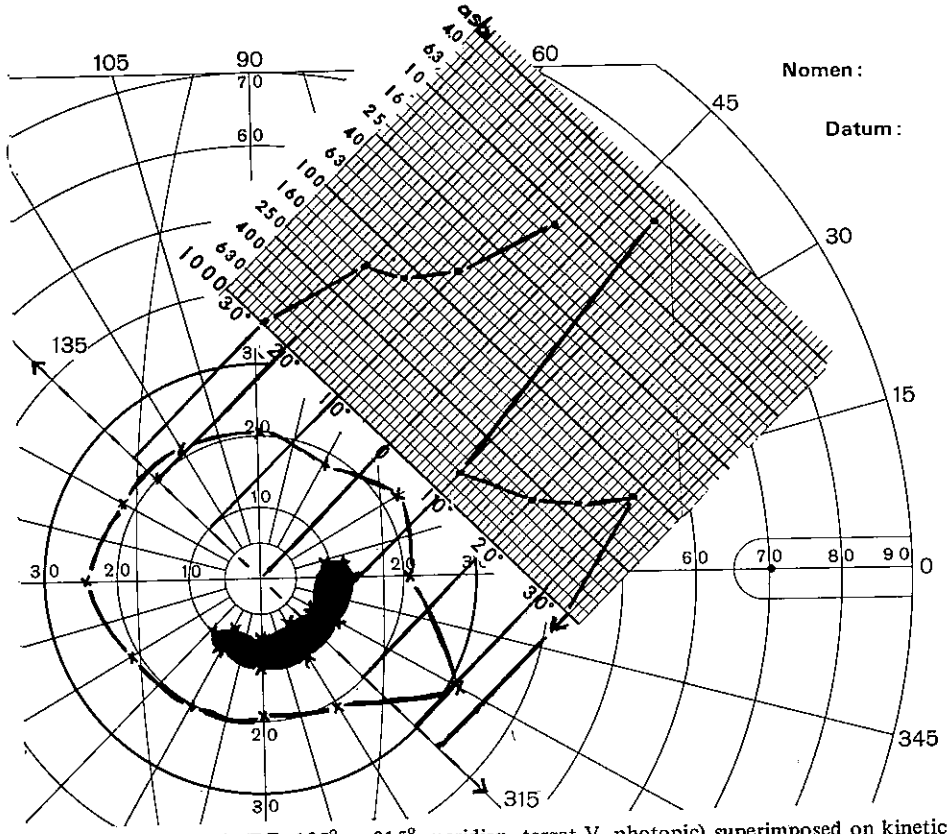

Figure 2. Static perimetry graph (RE, 135° – 315° meridian, target V, photopic) superimposed on kinetic field (target V4e). The defect is more thoroughly quantified by static examination.

(2) Background illumination and state of adaptation.

Scotopic testing takes place with the background illumination totally extinguished after the subject has been fully dark adapted. Illumination is increased to 10 asb for mesopic conditions and 31.5 asb for theoretical photopic conditions on the Goldmann perimeter. An apostilb is a unit of light measurement.

Dark adaptation is a phenomenon that is still not fully understood but clinically its effect in the normal is to lower the threshold of the visual elements dramatically, particularly of the rods, and enhance contrast. There is a slight shift in sensitivity towards the blue end of the spectrum. The state of adaptation will therefore have a marked effect on results obtained. (see fig. 3)

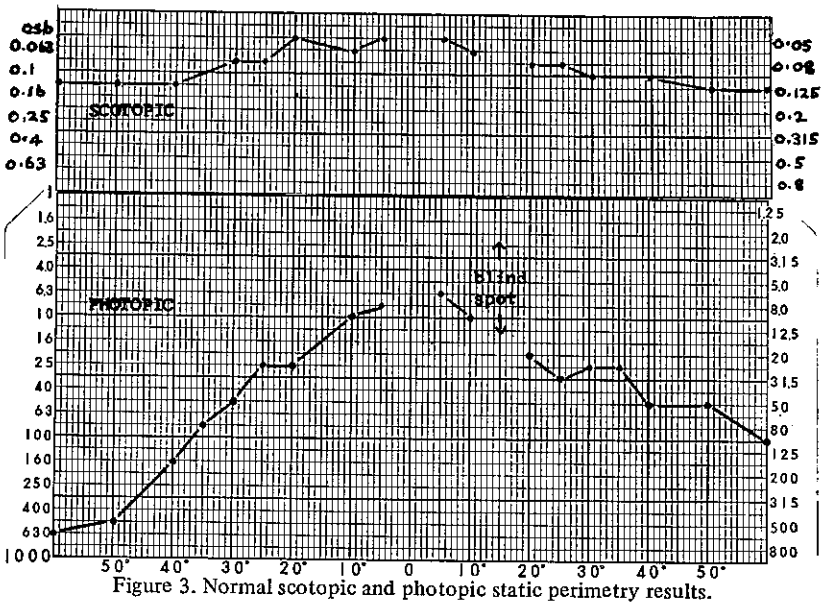

Figure 3. Normal scotopic and photopic static perimetry results.

(3) Colour of target and colour perception.

It must be remembered that four different responses can be elicited from a patient undergoing colour perimetry:

a) movement is seen (in kinetic perimetry)
b) an object is seen with no colour
c) an object is seen with a difference in the saturation of the colour
d) an object is seen with the correct colour.

The amount of stimulus produced by a target is a product of its size and luminosity. In perimetry it is usual to test with coloured targets larger than the white targets as the purpose is to stimulate a larger area of the retina with a reduced intensity.

As colour is a subjective sensation it is very difficult to standardize results accurately. The use of monochromatic light as from a laser would be an advantage.

(4) Size of target and spatial summation.

A single quantum is sufficient to activate a rod and the effect on nearby rods is added up by the visual system. A quantum is an indivisible packet of light energy. As a greater number of rods will be stimulated an increase in the size of target therefore increases its stimulus value.

Spatial summation increases with distance from the fovea and is greater for rods than cones, but inversely there is a gradual decline in sensitivity to size and brightness peripherally, with a decrease in receptor density.

On the Goldmann perimeter a scale of stimuli values has been calculated[5] for the relationship of target size to the neutral density filters, with background illumination of 31.5 asb. This simplifies the expression of quantitative perimetry which has increased in complexity from Goldmann's original concept. It is based on the graded steps of the three sets of filters in which the density markings =, – , no bar = descending steps of 2 lot units, markings 1,2,3,4 = steps of 0.5 log units, markings a,b,c,d,e = steps of 0.1 log units.

(5) Presentation time and temporal summation.

It was found that a flash shorter than 0.1 second duration had no effect on threshold.[2] Therefore to ensure the activation of temporal summation and so ensure that threshold contrast is independent of presentation time a minimum time longer than this should be adopted. With allowances made for psychological factors, such as alertness, it is advisable to have a presentation time of 0.5 to 1 second for clinical perimetry.

(6) Pupil size and retinal adaptation.

The size of the pupil only theoretically affects the extent of the visual field. However it has a slightly more significant effect on the illumination of the retina, the brightness of the retinal image and the resolving power of the eye. So, for absolute accuracy, photopic perimetry should be avoided when the pupil is dilated.

(7) Refractive error and resolution.

According to present data there is negligible

effect of blur on perimetric threshold from 35° to the periphery. Consequently the refractive correction for the testing distance (30 cm.) should be added from 0° to 30° as in kinetic perimetry.

(8) Age of patient and retinal sensitivity.

Dark adaptometry and kinetic field testing both show slight changes in standard variation according to age. This could therefore be expected with static perimetry and is being investigated further at present.

PSYCHOLOGICAL FACTORS

The psychological factors which abound in a clinical situation inevitably affect perimetric accuracy. Recognition of these factors and adaption of one's technique to avoid their influence as much as possible is the responsibility of the perimetrist.

Alertness, co-operation, understanding, motivation and freedom from anxiety are desirable qualities to stimulate in the patient. So often, instead, one is confronted with fear of the diagnosis of disease, fear of responding incorrectly, over-anxiety to please, fatigue and inattention due to the age of the patient, effect of drugs and maybe preoccupation with hunger, thirst or time.

Objectivity and accuracy should be paramount. These are best attained through careful explanation to the patient of the requirements and emphasis that alertness will trigger off some false responses which the perimetrist will be prepared to eliminate. Fixation must be checked continually. Under scotopic conditions the infra-red beam or similar attachment would be invaluable but otherwise periodic excursions into the blind spot region can help check fixation.

VALUE

The value of static perimetry lies in:—

a) the quantifying of defective as well as apparently good areas of vision in the field which has previously been examined by kinetic methods.
b) the precise recording of slight changes in the visual field which can be made with serial examinations in order to follow the progress of a disease.

It is a sensitive form of testing for both diagnostic and prognostic purposes. If one realizes the truth of the statement "the diagnosis of an observed scotoma is always a statistical decision and not an absolute matter"[6], the value of static perimetry becomes apparent.

CONCLUSION

It has been shown that a number of interrelated factors influence the accuracy of static perimetry results. These results should be assessed, for diagnostic and prognostic purposes, against the standard deviation.

Ideally the statistical data for this are obtained from the same clinical environment as that in which the abnormal is examined, that is the one in which these factors are all in force.

A skilled perimetrist will combine constancy of method, understanding of the psychophysical factors described here and understanding of the defect to be investigated and is thus capable of obtaining accurate, reproducible retinal profiles which can be assessed in relation to the normal and to subsequent recordings.

The value of automated static perimetry is evident[7] but must be weighed against that of an experienced perimetrist who is also capable of other skills in an ophthalmic practice or clinic.

Acknowledgement

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EXAMINATION OF VISUAL FIELDS IN THE PHYSICALLY HANDICAPPED CHILD

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Abstract
Examination of visual fields in the physically handicapped child presents a challenge. Using the Friedman visual field analyser, a form of static perimetry, acceptable accuracy, speed, repeatability and a permanent record is obtained. Information gained forms part of the data on which classification, treatment and the rehabilitation program are based.

Key Words
Perimetry, handicapped, rehabilitation.

INTRODUCTION

Examination of visual fields in the physically handicapped child presents a challenge. Most forms of perimetry are too difficult for these children, requiring a higher degree of concentration for a longer period than can usually be sustained and a degree of subjective response that cannot usually be relied upon. For this reason, the simple confrontation method of visual field testing was used on over 300 physically handicapped children examined in a visual screening program at Yooralla Society of Victoria during the past four years. However, it was found that this test was providing information with a low level of accuracy and reliability because of the higher incidence of supra-nuclear gaze and fixation maintenance disorders and the often very slow or unreliable subjective verbal responses. Over the past nine months in an effort to obtain reliable visual fields the Friedmann visual field analyser has been used as part of this screening program and the results are discussed.

METHOD

The Friedmann visual field analyser is used to examine the central visual fields for the presence of a defect. Each eye is separately examined. Static illuminated targets are presented 2, 3 or 4 at a time. In total, 46 targets are displayed in 15 separate presentations. The light intensity of the targets may be varied. The patient is required to indicate the number of lights displayed in each presentation.

In testing these children we used maximum light intensity of targets at all times for all children, irrespective of age, and used dim room illumination. In most cases the patient was asked to point with his hand to indicate the position and number of lights seen, since many of the children are unable to count accurately. The examiner must sit beside the instrument facing the patient to ensure accurate fixation of the white central target at the time the firing button activates the light flash which illuminates the targets. It is easier to use the remote control firing button rather than the button at the rear of the instrument. When testing we displayed the targets in reverse order.

RESULTS

During the past nine months 46 children between the ages of seven and 16 years have been examined using this method. Reliable results have been obtained on 35 children. The unreliable results were mainly found among the younger children due to inattention, but two of the older children failed to produce reliable responses, one because of severe manifest nystagmus and one refused to co-operate. It was found that the actual testing took only three minutes per eye. However, it often took up to 10 minutes to correctly position the child at the instrument because of difficulty adjusting to the extremes in size and mobility of

the children. Wheelchairs, standing frames and calipers present special problems as do physical disorders such as hypotonia, hypertonia, deafness and dribbling.

When it was possible for a second person to assist the examiner by recording the results it was easier to maintain the child's attention and concentration and the test was performed more quickly.

Targets were presented in reverse order because this meant that the more central targets were presented first, allowing the child to more readily understand what was required.

Children who were hyperactive, with a short attention span were tested twice and if still unreliable, listed to be checked again in 12 months.

CONCLUSION

The ability to provide accurate, repeatable visual fields in physically handicapped children has wider value than just as part of the ophthalmic assessment of the child where it can help in determining the aetiology, site of lesion, classification of ocular defect and ocular management generally. Medical, para-medical and teaching staff frequently request information about the visual fields of such children which we are now able to provide. The information allows the rehabilitation program to be appropriately modified where visual field defects are present.

SUMMARY

The Friedmann visual field analyser is a useful test to the orthoptist engaged in the examination or treatment of handicapped children. The method has the advantages of acceptable accuracy, speed, repeatability, is a portable test and provides a permanent record.

FREE SPACE STEREOTESTS REVISITED

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Abstract
Despite a long history, free space stereotests have never found widespread acceptance. It is now becoming apparent that such stereotests do have a role to play in orthoptics. A new free space stereotest is described and evaluated.

Key Words
Free space stereotests, screeners, stereopsis, stereo-wedge.

To the majority of orthoptists, the evaluation of stereoscopic vision is an important aspect of patient management. In a recent survey of Australian orthoptists[1], 90 out of a total of 97 respondents rated the efficient evaluation of stereopsis as either important or very important. Many of the orthoptists, however, felt that there was a need for new tests to be developed and they gave suggestions as to the properties of such tests. The suggestions which occurred most frequently were that the tests be:

1. performed in free space to avoid test induced dissociation,
2. simple to use and hence easy to explain to patients,
3. able to give an indication of the patient's ability to use binocular depth perception in every-day activities,
4. suitable for mass screening applications, particularly with young children,
5. inexpensive,
6. free from significant learning effects.

It must be emphasised that any test which complies with these suggestions will be semi-quantitative at best, as it is impossible to eliminate monocular depth cues from free space tests. It appears that many orthoptists are willing to accept this disadvantage in order to make use of the advantages which are associated with free space tests.

Do any of the existing free space tests comply with all of the above criteria? Most of the traditional multi-rod tests (e.g. Helmholtz three pin test[2], Howard-Dolman test[3], Hering Dropping test[4]) are bulky and therefore not portable; this limits their usefulness as screeners. The results yielded by such tests have always proven difficult to interpret as they show little cross-correlation[5]. The tests generally require that the subject be trained before he can use them effectively[6]. While the Ames leaf room[7] appears to be very sensitive to the presence of "gross" stereopsis[8], its bulk prevents it from being used as a screener. The Verhoeff stereopter[9] is portable and thus is able to be used as a screener. Verhoeff deliberately introduced conflicting monocular depth cues to his test. The reasoning which led Verhoeff to introduce those cues has been questioned by Sloan and Altman [10]; they feel that "tests in which monocular and binocular clues are in opposition may give misleading information". This could particularly be the case when young patients are being tested, as they could easily become confused.

The only free space tests which are generally available are the Frisby test[11] and the Lang pen test[12]. The Frisby test complies with most of the above criteria but, as it is composed of random textures, it is difficult to explain to young or retarded patients. The Lang pen test appears to come closest to meeting the criteria. Because it involves the performance of a simple depth judgement task, it is actually giving a measure of the usefulness of the subject's binocular depth percep-

Australian Orthoptic Journal,
1980-81, Vol. 18

tion. The test is suitable for use with both adults and children, it is portable and involves negligible expense. It is therefore suitable for use as a screener. The test does have a very serious drawback: it relies on the examiner to make a subjective judgement of the patient's performance. For an examiner who has little or no binocular depth perception, this could prove very difficult. Under such conditions it is difficult to ensure than an examiner will give consistent performance estimates from one patient to the next. Despite these problems, the Pen test has the potential to become a very useful addition to the orthoptist's test array, it has therefore been used as the starting point in the development of a new "pen test". The new test, called the "Stereo Wedge", is illustrated in Figure 1. The device consists of two wedges whose apices are vertically aligned. Between the wedges is a scoring plane, which has a scale marked on it. The scale is calibrated in seconds of arc and reads 100, 200, 400 and 800 and 1600 sec. of arc on either side of the centre line. Because the test is intended to be used with children, a viewing distance of 1/3 metre was chosen.

How the Test is Used

The handle of the test unit is held horizontally and at right angles to the line of sight of the patient. The scoring plane is directed toward the patient in such a way that he is unable to make use of monocular cues. For example during binocular testing, the unit is aligned so that the plane points towards the eye which is on the side of the "writing hand".

The first trial is performed binocularly. The patient is asked to slowly bring a felt-tip pen in from the side and to touch the scoring surface of the test unit directly between the apices of the wedges. The patient's performance is read off the scale. If the mark is on the "patient side" of the zero line, the score is assigned a +ve value and if on the "examiner side" it is made -ve. The binocular trial is repeated at least once. If desired, the standard deviation of the trials can be calculated, as can an absolute mean (i.e. all scores treated as +ve). The binocular performance can then be compared with monocular performances by repeating the trials with right and/or left eye. The binocular performance should be both more consistent (less

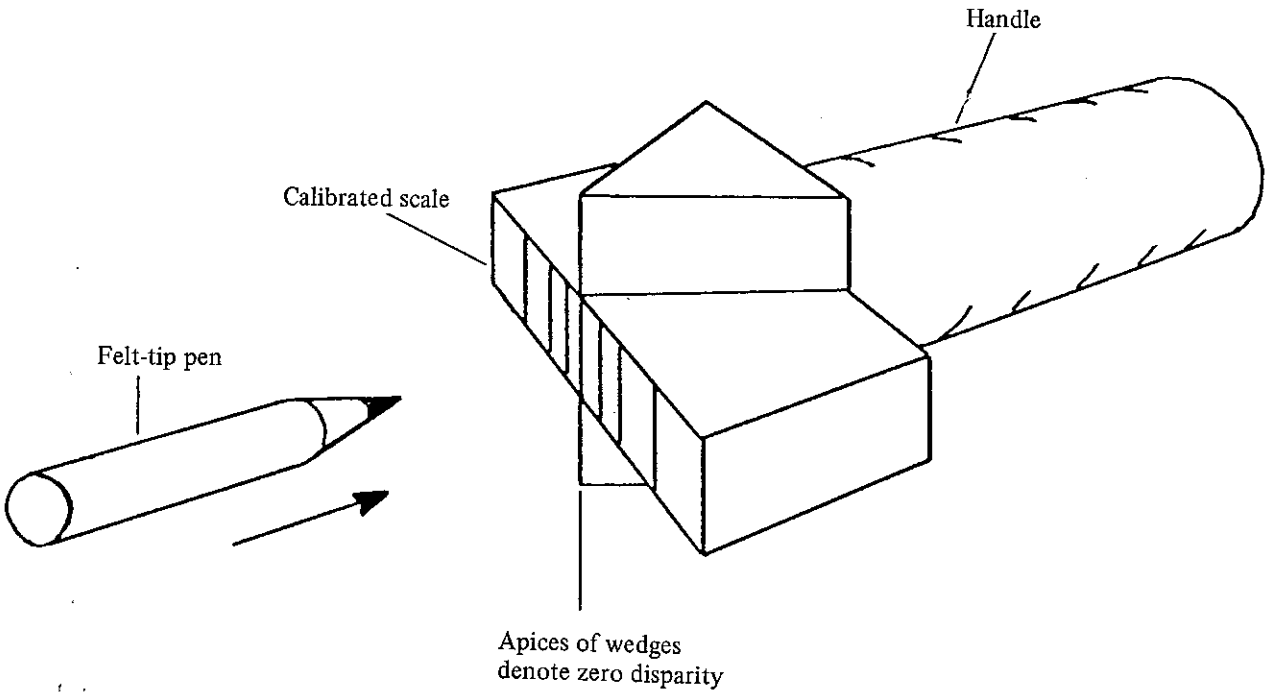

FIGURE 1 A schematic of the new pen test, the "Stereo Wedge"

spread or smaller standard deviation) and more accurate (consistently closer to the centre line, or smaller absolute mean) than either of the monocular trials. The binocular trials are performed first so that any improvement in performance, which occurs with practice, tends to reduce the difference between binocular and monocular trials. This should ensure that a significantly superior binocular performance is a result of the presence of useful stereopsis and not an experimental artifact.

The only precaution which must be taken is to ensure that the patient does not move his head. This precaution must be applied to all free space tests, as movement of the head introduces significant parallax cues.

A damp tissue is used to clean the scoring surface between each trial. The main reason for cleaning the surface regularly is to give the patient time to "forget" how far away the test is being held, this prevents him from using the length of his arm as a cue.

Evaluative Trial

A rigorous evaluative trial has been performed and will be discussed in statistical detail elsewhere[13]. In these experiments the patients attempted to mark the scoring plane, between the apices of the wedges, at least four times for each of the binocular, right eye and left eye trials. This allowed statistical analyses to be performed. Otherwise test methods were as described above.

Sixty-eight subjects participated in the evaluative trial. Each subject was categorised into one of five groups: normals (22 subjects), heterophores (22), convergent squints (14), divergent squints (5) and abnormal retinal correspondence (5). The subjects in the normal group each had normal or corrected to normal visual acuity and apparently full binocular function. All trials were carried out by, or under the supervision of, qualified orthoptists. Three clinics and one college participated in the project.

RESULTS

Consistency of binocular performances, as compared to monocular performances, was tested by performing an F-test comparison of the true binocular and monocular standard deviations. For the normal group, the spread of the binocular performances was significantly less than that of the best monocular performance in 86% of cases (5% significance level). For the other groups, the binocular spread was significantly less than the monocular spread in 42% of cases. However of all 68 subjects, only five (7%) had a monocular spread smaller than their binocular spread, and three of these had no demonstrable stereopsis. Clearly and particularly in the case of normal subjects, stereoscopic vision does give an advantage in depth estimation when considered in terms of consistency.

A convenient measure of the accuracy of a performance is the absolute mean score. If the binocular score is significantly better than both of the monocular scores, then the patient can be regarded as having useful stereopsis. If the absolute mean score of the best monocular performance was worse than the sum of the absolute binocular mean and standard deviation, the binocular performance was classed as significantly better than the monocular performance. The results yielded by the stereo wedge are compared with previous diagnoses in Table 1. There were a total of sixty subjects who had been diagnosed as having useful binocular vision. Fifty-four (90%) of these responded positively to the stereo wedge. This result is comparable to those reported by Hinchliffe[14] in her evaluation of the Frisby test and it is superior to those reported by her for the Wirt/Titmus and TNO tests.

Previous Diagnosis			Correct +ve.	False -ve.
	Normal	(22)	20 (91%)	2 (9%)
Useful	Het.	(22)	20 (91%)	2 (9%)
	Con.	(9)	7 (78%)	2 (22%)
B.V.	Div.	(4)	4 (100%)	0 (0%)
	A.R.C.	(3)	3 (100%)	0 (0%)
	Total	(60)	54 (90%)	6 (10%)
			Correct -ve.	False +ve.
No	Con.	(5)	3 (60%)	2 (40%)
Useful	Div.	(1)	1 (100%)	0 (0%)
B.V.	A.R.C.	(2)	1 (50%)	1 (50%)
	Total	(8)	5 (62.5%)	3 (37.5%)

TABLE 1 Comparison of the previous diagnosis with results of the Stereo Wedge Test

Of the eight subjects who had previously been diagnosed as having no useful binocular vision, three yielded significantly superior binocular performances. While they have been referred to as "false positives" in Table 1, it appears more likely that they do in fact possess some form of useful stereopsis (probably coarse[15]) which has previously been undetected.

Overall Group Performances

The overall performance of the normal group was compared with those of the heterophore and squint groups. The results for the three groups complied reasonably well with expectations. The binocular performance of the normal group was the best, the heterophore group also performed well and both of these groups performed better than the squint group on binocular trials. Monocular performances for the three groups were quite consistent. This is in agreement with the results reported by Henson and Williams[16], who also found no difference between monocular performances of normal and strabismic subjects.

As a rule of thumb, it seems that if a patient can average better than about 250 seconds of arc absolute mean binocular performance on the stereo wedge, then he probably has quite useful stereoscopic vision.

Discussion

The results of the evaluative trial indicate that certain patients, who have poor visual acuity and a weak hold on their fusion, may still have useful stereoscopic vision. Such patients will often be falsely diagnosed as having no stereopsis by contemporary stereotests. The haploscopic tests will sometimes prove dissociative and even if they do not the fine texture used in many of the tests will limit their usefulness with these patients. Where such a patient is encountered, the stereo wedge test can prove very useful in indicating whether the patient has any residual coarse stereopsis.

Another area in which the stereo wedge may be useful, is as a demonstration to the parents of young patients of the importance of maintaining useful stereopsis. If the parent has a correct perspective on the motivation behind treatment, he or she is in a better position to encourage and support the young patient.

In conclusion, it is apparent that there is still a place for the free space testing of stereopsis. One such test, the stereo wedge, would appear to be particularly suitable for use both in the clinic and as a general screener.

Acknowledgements

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THE EFFECT OF PERIPHERAL FUSION ON THE 4 △ TEST

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Abstract

Fifty subjects were examined to assess whether peripheral fusion affects the response to the 4△ test to determine the presence of a central scotoma. The test was performed both with and without peripheral fusion stimuli. It was found that in 23% of cases with a significant heterophoria, or a small angle squint, the presence of a scotoma was only demonstratable when peripheral fusion is eliminated. In the light of the results it is suggested that the usual method of performing the test be modified.

Key Words

Peripheral fusion, four prism dioptre test.

The 4 △ test is clinically used to confirm an area of central suppression. The most effective use of this test, therefore, is limited to cases of small angle squint where a suppression scotoma of the foveal region of the squinting eye exists and no deviation has been found on cover test because the angles of eccentricity and anomaly coincide.

A 4△ prism causes sudden displacement of the foveal image to the parafoveal retina in one eye. Two binocular reflexes are thereby evoked. One is the refixation reflex which brings the image back to the fovea and the second is the fusional reflex which overcomes the diplopia induced by the monocular image displacement. Romano and von Noorden [1] state that both reflexes are probably initiated at the same time but because the velocity of the saccadic movement is 10 times that of the tonic movement, the fixation movement appears to precede the fusion movement.

In the event of central suppression the second fusion reflex is not elicited as the image is displaced into the scotomatous area, diplopia is not recognised and the fusional response fails to occur. This is described, for the purpose of this study, as a monocular response. However, Duke Elder [2] states that there is a form of peripheral fusion that occurs in the presence of a central suppression scotoma which may be demonstrated even if the deviation is gross.

Thus, the purpose of this study was to investigate whether peripheral fusion plays any part in eliciting the second fusional response to the 4△ test in subjects with central suppression. If so, then peripheral fusion is affecting responses of this test previously used to note the presence of central fusion.

To do this, the test was carried out by two different methods:

i) In free space – A fixation stick with a small dark spot drawn on it was used for fixation and held at 1/3 m from the subject at eye level. A 4△ prism was brought down over the dominant eye (i.e. the suspected fixing eye or the eye with the best VA) from above. The responses of the eyes were observed closely. This procedure was usually carried out 3 or 4 times to ensure consistency of results. In this condition peripheral and central fusion were allowed to act.

ii) When peripheral fusion was eliminated – to eliminate peripheral fusion surrounding objects that would stimulate peripheral retina while fixing a spot target had to be eliminated. Initially, it was decided to instruct the subject to fix a small coloured spot on to a blank wall or to fix the small spot on the Bjerrum screen 1/3 m from the subject. This proved unsatisfactory as it was very difficult to observe the subject's eyes and clues to peripheral fusion were presented when placing the prism over the subject's eyes as this could only be done by standing beside and in front of the subject. Therefore, another method of eliminating peripheral fusion was devised.

A large white card with a spot in the centre was made up. The size of the card was determined by the area of the binocular field when fixing a spot at 1/3 m, this area was calculated as 34 cm up; 72 cm down and 48 cm either side of the fixation spot. By using this card stimulation of peripheral retina could be eliminated effectively.

The subject was instructed to fix the spot on the card which was held at 1/3 m at eye level. The eyes were observed through a hole in this spot. Another person would stand behind the subject, placing the prism over the suspected fixing eye while the responses were noted. To ensure consistence of responses this procedure was also performed 3 or 4 times. This test was performed with the prism base in, in the presence of an exo deviation.

For obvious reasons the 4△ test was not performed for 6 m as it would mean that a completely blank room would be needed to eliminate the peripheral fusion response.

Of the total 50 subjects tested:

- 10 (20%) were controls, having only a small latent deviation present (9 exophorias/1 esophoria)
- 24 (48%) had a moderate to large latent deviation > 5△ (7 esophorias/17 exophorias)
- 16 (32%) had a small angle squint (14 esodeviations/2 exodeviations)

Visual acuity of 6/18 or better in the less dominant eye and a positive response to the Wirt-Titmus test were necessary criteria for all groups.

Peripheral fusion was considered to be playing a significant part if a different response was observed when the test was performed under each of the two conditions. If peripheral fusion was being used it would be reasonable to suspect that there would be a binocular response in free space and a uniocular response when using the large white card.

RESULTS

Control Group

In the control group all subjects showed a binocular response under both testing conditions, signifying that no central scotoma was present and central fusion was being used to elicit the second fusional reflex.

Heterophoria Group

In the second group of 24 moderate to large latent deviations it was found that 15 (approx. 63%) of the subjects seen showed a binocular response under both testing conditions, i.e. central fusion was being used to elicit the second fusional response even when peripheral fusion had been eliminated.

7 of the subjects (approx. 29%) showed a change in response, i.e. a binocular response was observed in free space and a uniocular response observed when peripheral fusion had been eliminated, suggesting that there was a significant amount of central suppression present and the deviation was being controlled by peripheral fusion.

All these 7 subjects had a good VA (better than 6/9), had stereoacuity of 80 seconds of arc or better on the Titmus test and all except one showed good recovery movements to cover test. These patients had a mean heterophoria measurement of 29△ which is considerably larger than the mean measurement of 15 △ of those showing a binocular response under both conditions.

2 subjects (approx. 8%) in this group showed a uniocular response to the 4△ prism under both testing conditions. This confirmation of central suppression suggests that these 2 subjects had a small microtropia that was previously undetected.

Small Angle Squint

In the third group of 16 small angle squints, 3 subjects (approx. 19%) showed a binocular response in free space and a uniocular response when peripheral fusion was eliminated, i.e. these subjects would not have been diagnosed as a microtropia by this test under the conditions usually used.

It was noted that all three cases had a large super-imposed heterophoria.

These findings are summarised in figure 1.

Response	Control Group	Hetero-phoria	Small Angle Squint
Binocular response under both conditions	10	15	–
Binocular response in free space. Uniocular response when peripheral fusion is eliminated	–	7	3
Uniocular response under both conditions	–	2	13
Total	10	24	16

Figure 1 Responses of each group to the 4 △ test when performed with and without peripheral fusion stimuli.

CLINICAL SIGNIFICANCE

Of the 44 patients with a squint or significant heterophoria, 10 (23%) showed a uniocular response to the test only when performed in the absence of a stimulus to peripheral fusion. This suggests that the presence of a central scotoma may be overlooked when this test is carried out in the conventional manner. In order to be entirely accurate it is suggested that the usual method of performing the test be modified to reduce the effects of peripheral fusion.

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THE DEVELOPMENT OF OCULAR FIXATION

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Abstract
Literature presented over the past ten years which relates to the development of ocular fixation is reviewed. From consideration of the results of this survey, the importance of the human face is emphasised in the development of fixation or visual attention and therefore visual, physical and social functions of both the normal and handicapped infant. Possible strategies to permit maximum visual development of handicapped or institutionalised children are discussed as the results of these findings.

Key Words
Fixation reflex, binocular reflexes, child development.

In the course of clinical practice, orthoptists are frequently being asked for help by parents and by members of associated disciplines, who are involved in the overall development of the patient, especially where the patient is handicapped. An analysis of the reported studies of visual attention and fixation of infants is presented to assist orthoptists in these areas. As orthoptists we are aware of how important it is to accurately test the fixation ability of the eyes to disclose the maximal information about an ocular deviation. To encourage the use and development of the function, it is also important to find which objects most interest the human baby.

FIXATION TARGETS

As the true visual acuity of the human baby is not known but is generally considered less than maximal, it may be advisable to think of fixation in the new born as being visual attention which then develops to fixation. Many articles such as that presented by Maurer and Salapatek[1] report the work of Fantz who, between 1963 and 1967, revealed in several studies the preference of new born infants to fixate or attend the human face rather than a coloured disk, bull's eye target, newsprint, a red square, or a lighted orange globe.

Goren *et al*[2], following this important work pioneered by Fantz, studied 40 newborn infants whose mean age was 9 minutes, and found that they significantly turned their head and eyes to follow a face-like stimulus (where the arrangement of eyes, nose and mouth closely approximated the normal face) but not to follow a face-like arrangement (a shape with the mouth situated on the forehead and one eye situated on the chin), or a blank form.

In further defence of the face as a fixation object of choice, Ellis[3] in a review of "face recognition" reports several studies which tested memory recognition of pictures by adults. The study compared the ability to memorise and recognise faces, snow crystals, buildings, dogs and inkblots. The recognition of faces was always best. The facial features were ranked in the order recognized, i.e. eyes, nose, mouth, lips or chin, hair and ears. Infants were found to concentrate on the eyes then the mouth. Inverted faces were found more difficult to recognise and, interestingly, infants aged 5 to 6 months could differentiate a novel face from a normal face except when the pictures were inverted. (Perhaps this is a good reason for not standing behind or above a baby's head.)

Earlier this year in Brisbane Creig Hoyt[4], when discussing "how babies see", commented that the face was a good test to use to assess the fixation ability of a baby. He suggested using a paddle twice the size of a ping pong bat with a face painted on it, as a fixation target. As there is a wide experimental backing to this choice of target, it is easy to see why such an object should be

successful. It also seems logical that the choice of a toy with features that resemble the human face would be an ideal fixation target.

Hoyt however suggested that toys have limitations as some babies may be frightened or upset by our choice. To reduce this problem, the use of a toy from the patients home may help.

Within our family both our children at an early age have demonstrated a preference, out of quite a range of toys, for those which are large and have facial features that closely resemble the human face. In the absence of the real human each child has spent considerable time gazing at, chatting to, then ultimately forming an attachment to the facsimile. Their choice is clearly predictable from the quoted experimental studies.

It therefore seems logical that the use of a toy with facial features resembling those of a human may prove useful in institutions with limited staff or in clinical practice where visual fixation is to be encouraged as the first step in normal ocular function. This choice of toy will also prove a good present for a new baby!

Dr. Serfontein in his paper[5] described the need for sensory input to activate attention as a developmental stage in infants. Thus by attracting visual fixation or attention we may not only be stimulating visual function but also, by the continuous use of the appropriate stimulus, promoting a stage in the overall development of a child.

Having established that the human face has such attraction for the baby, workers in the experimental field have turned to the analysis of the features which most attract infant fixation.

Again, Fantz and Miranda[6] have revealed that infants under 7 days of age are attracted to curved rather than straight objects. Ruff and Birch[7] studied infants aged 13 weeks to see their response to a design made up of concentric, curved and multi-directional lines. Each of these dimensions was, in varying degrees, found to be effective in attracting fixation.

This information suggests that in the absence of face-like fixation objects, for both assessment and training of ocular function, objects made up of curved multi-directional lines should be used. Certainly, as stated by Hoyt, the favourite fixation light does not fit sufficiently with this criteria to hold the infants attention and, in addition, the glare of the light is likely to deter the patient.

CHRONOLOGICAL DEVELOPMENT OF FIXATION

The following summarises the experimental evidence on how the fixation of human infants functions between birth and 14 months of age:

WEEK 1:

Hoyt[4] stated that 94% of babies fixated the human face *within 30 seconds* of birth. The pattern of fixation shows that the eyes look at the edge of the face near the ears.

Goren *et al*[2] found that at a mean age of *9 minutes,* babies significantly turn their eyes and head to follow a face.

Slater and Findlay[8] found that babies with an approximate mean age of *6 days* could converge accurately to test targets 10 and 20 inches from the eyes. A target 5 inches from the eyes produced monocular fixation only.

WEEK 3:

Haith *et al*[9] stated that babies fixated 22.1% of the time they were studied.

WEEK 4:

Maurer and Salapatek[1] found babies looked at their mother less than other test faces of unknown males and females. Their fixation was mostly off the face and when on the face, their eyes moved around the border predominantly to the chin and hairline.

WEEK 8:

Maurer and Salapatek[1] found that whilst babies in this age group changed their fixation as often as babies at four weeks, they looked on the face more, moving their eyes around the border. When fixating inside the face, they looked most frequently at the eyes then the mouth.

Scaefe and Bruner[10] assessed an infant's ability to interact with an adult who, after establishing eye to eye contact, cued the infant to look at laterally displaced fixation objects. At this stage there was a 30% positive response.

Hill[11] elicited horizontal optokinetic nystagmus in all infants tested at this age.

WEEK 11:

Haith *et al* found that by this stage fixation had increased to 89.9% of the time under study. When the subject being fixated spoke, the infants fixation become more confined and particularly so to the eye area.

Hill[11] found that by this age, 100% of infants tested could converge, and demonstrate horizontal and vertical saccades, although with some overfixation.

MONTH 5:
Wilcox and Clayton[12] noted that regardless of facial expression, movement of the face attracted better fixation.
MONTH 11-15:
Scaefe and Bruner[10] found that by this age the positive response to a cue from an adult to look laterally was 100%. The authors suggest that the older the infant, the more they require active human interaction.

It can be seen from the above that fixation functions at birth. It is not until the baby is eight weeks old that he endeavours to look inside the border of the face and then mostly at the eyes, then the mouth. At this same age of eight weeks babies start to interact with adults and react to visual clues to look laterally.

To assist the development of fixation it is apparent that the human face or its substitute is necessary from birth. It is possible that a more passive form of stimulus, such as a toy, will suffice for the first eight weeks. Towards the end of this period and definitely by week eleven, the time a baby will fix has increased to around 90% of the time and a speaking subject helped to concentrate the fixation. The work of Ellis has shown that it makes no difference whether the face is black and white or coloured, nor whether the pose is frontal, three quarter, or full profile. However, as Wilcox and Clayton[12] have shown, an active human face is necessary to attract attention. In the absence of parents perhaps a video tape of an adult talking may help. As it has been noted that babies from 4 weeks can differentiate strangers and tend to look at these faces more often than the familiar human, the help of voluntary workers to talk to the institutionalised infants could be of great value in assisting both ocular and social development.

CONCLUSION

The experimental studies by workers outside the field of ophthalmology have demonstrated how valuable the human face is in attracting ocular fixation or attention. Usually the normal home environment provides sufficient stimulation to develop the fixation function. However where this is not possible the use of toys, films, television and volunteer workers may assist.

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INFANT ESOTROPIA: PILOCARPINE TREATMENT

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Abstract

A review of 263 cases of infant esotropia presenting over a 10 year period and treated with pilocarpine alone or pilocarpine in combination with standard therapy revealed an unusual proportion of fully binocular results.

Key Words

Infant esotropia, miotic therapy, pilocarpine, early treatment, survey, results.

INTRODUCTION

In 1977 a retrospective survey of all infant cases seen in a solo orthoptic practice over the previous 25 years was undertaken and the results showed an increase in the proportion of very young children examined and treated, and a rise in the proportion of fully functional results[1].

There was a fall in the proportion of large angle strabismus cases which was attributed to earlier detection of the strabismus while the deviation was still small and/or intermittent and, to a lesser extent, to improved methods of treatment, involving miotics and less use of glasses and surgery.

The purpose of this paper is to discuss the cases which had miotic drops solely or as a part of their treatment regime. There were 263 such cases out of a total of 750 infants seen. These cases presented between 1967 and 1976 and all had an esodeviation.

The earliest use of miotics was reported in 1892[2] although eserine was suggested as far back as 1870[3]. In 1949, with the work of Abraham[4] miotic therapy became popular. Many studies were undertaken and have been reviewed by Goldstein in 1968[5].

The problem has been to find a miotic which could be used without undue side effects especially in very young children over a long period of time and which would be sufficiently long acting to be useful in strabismus.

Side effects of D.F.P. (di-isopropylfluorophosphate) and phospholine iodide (eothiopate iodide), which are in the anticholinesterase group of drugs, include blurring of vision, ciliary injection, headaches, iris cysts, cataract formation and the dangers of concurrent scoline-type anaesthesia. These drugs are thus unsuitable although they have a long action which would be an asset. Pilocarpine, a much milder miotic, acting directly on the parasympathetic effector cell, had lost favour because it's effect is often erratic and too short acting in its usual presentation[6]. However, pilocarpine is now available in vehicles such as polyvinyl alcohol and hydroxypropyl methylcellulose which have enhanced its effect in strabismus therapy (as well as in glaucoma) by prolonging its effect even at low concentrations. Pilocarpine in a mixture of long-chain polymers (adsorbobase) will soon be available and promises to be even better.[7,8 and 9]

Pilocarpine in polyvinyl alcohol base was used most often in this series. Some children who preferred the methylcellulose base used it. No child had treatment suspended because of side effects or inability of the parents to carry out the routine instillations.

SUBJECTS AND METHODS

Between 1967 and 1976, 263 esotropic infants under 36 months of age at initial examination were treated with pilocarpine drops. In 130 cases this was the only treatment and in 134 it was only part of their treatment. There were 137 males and 126 females; 32% (84) had large angle ($> 12°$) esotropia and 68% (179) had small angle and/or intermittent esotropia.

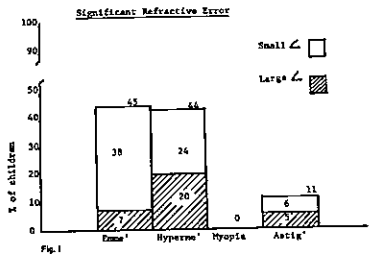

FIGURE I
Significant Refractive Error

Hypermetropia and emmetropia accounted for almost equal numbers of cases (44% and 45%). 11% had significant astigmatism. No cases of myopia were recorded. (Figure 1.)

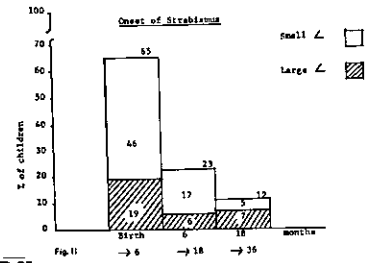

FIGURE II
Onset of Strabismus

Analysis of the onset of the strabismus (Figure II) shows a high incidence in the birth to 6 months age group (65%) even in the small/intermittent cases.

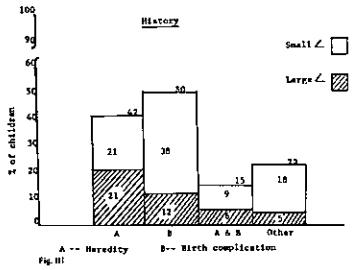

FIGURE III
History

In view of this finding, history of heredity and birth complications were studied (Figure III).

Birth complications, including prematurity, difficult delivery, long labour, rapid delivery, anoxia and factors which the parents and referring doctors considered to be significantly abnormal, occurred in 50% of cases. There was a familial history in 42% of cases. However, the combination of both factors was only evident in 15% of cases.

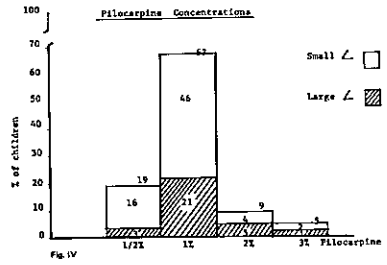

FIGURE IV
Pilocarpine Concentrations

Figure IV illustrates the concentrations of pilocarpine used. 1% was the most usual strength.

Infants were first prescribed 0.5% pilocarpine in polyvinyl alcohol for daily instillation on waking. This was soon increased to a twice a day routine. Strength was increased if necessary and occasionally the drops were used three times daily for short periods, during stress such as teething.

Other methods of treatment were included where necessary such as part time occlusion for amblyopia, glasses and surgery. The aim in each individual case was to achieve straight eyes during all waking hours as soon as possible so that normal visual acuity and binocular function could develop.

Duration of pilocarpine treatment varied between one month and 27 months (with a mean of seven months) in the large angle group. In the small angle group it varied from one to 72 months with a mean of 8¼ months. The two cases using pilocarpine for 72 months did so because the deviation could be controlled with the miotic and they had declined surgery.

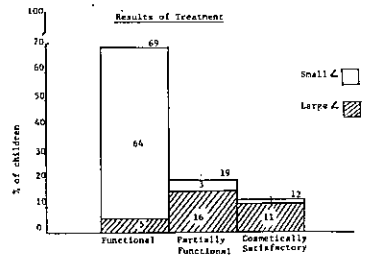

FIGURE V
Results of Treatment

RESULTS

Of these 263 cases (Figure V) 69% have a fully functional outcome while 12% achieved only a cosmetic improvement. Even those cases with a partially functional result have some useful "hold" and should be able to avoid a tendency to consecutive deviation in later life.

TABLE 1

Types of treatment and results
Comparison of Large Esodeviation (n=84) and Small Esodeviation (n=179)

		Treatment							
Number Cases		D only	D&O	D&G	D&S	D&O &G	D&O &S	D&G &S	D&O &G&S
N cases	Large	0	67	47	75	42	61	41	36
N cases	Small	130	34	17	8	7	3	1	0
Treatment Results: Cases achieving									
Functional.	Large	0	9	5	8	5	7	2	2
	Small	126	29	14	5	5	1	0	0
Partially functional.	Large	0	32	25	40	23	31	24	22
	Small	4	3	2	2	1	2	0	0
Cosmetically satisfactory.	Large	0	26	17	27	14	23	15	12
	Small	0	2	1	1	1	0	1	0

(D = drops O = occlusion G = glasses S = surgery)

Table I gives an analysis of the treatment schedules used in both groups, correlated with the results achieved. There is a high proportion of fully functional results in the small and/or intermittent group particularly in those cases where miotics was the only method of treatment required. Where occlusion also had to be employed results were still reasonably good, but where the whole repertoire of treatment methods (the DOGS) were necessary fully binocular results were few.

Very few cases of large angle esotropia attained a fully functional result even with early referral and treatment. The outcome in these cases has been discussed elsewhere.[10]

DISCUSSION

The use of pilocarpine for very young children with esodeviation was advocated by Whitwell in 1962.[11] It had been used by Knapp and Capobianco in 1956 [12] and Mayou in 1959 [13] but it has only recently been available in a vehicle which renders its effectivity sustained and prolonged. Pilocarpine in polyvinyl alcohol and in methylcellulose appears to control an early, small angle or intermittent esotropia for up to six hours. Side effects are few and parents readily co-operate with the treatment when they can see an immediate improvement in the child's condition.

Refractive error was not a significant factor in this group of infant esotropia which suggests that convergence control was not effectively linked with these young children's accommodative ability (AC/A factor). Miotic treatment at an early stage may have given the system enough support so that the eyes could begin to respond binocularly and synchronously.

Baker and Parks [14] believe that accommodative esotropia exists in infants under 12 months of age and that small angle congenital esotropia can deteriorate to a large angle deviation during the first year of life. Results in our studies support these views.

In those cases where there is significant refractive error miotics will also be useful. The pinhole effect can produce the desirable, clear, foveal image.[15] [16] and [17]

Large angle esodeviation does not appear to respond to pilocarpine so other methods of treatment should be employed. Pilocarpine is more effective in small or intermittent esodeviation where some binocular function is present. It does not work well in the presence of amblyopia which should be overcome as soon as possible.[5] and [18]

It is interesting to note the high incidence of birth complications especially in the small/intermittent group which ultimately proved to have the best results. This suggests that cortical binocular mechanisms were intact and could begin to function normally as soon as peripheral influences became stabilised with adequate treatment.

CONCLUSION

Good results in early onset esodeviation can be achieved in many cases.

Infants should be referred for investigation and treatment as soon as a deviation is suspected. Treatment with mild miotic drops such as pilocarpine in the newer bases have few if any side

effects and have been shown to be reasonably effective and acceptable to infants and their parents.

Acknowledgements

I would like to thank Dr D. B. Dunlop for allowing me to discuss these patients and Mr R. Bryant of the Royal Newcastle Hospital for his help with the illustrations.

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FOVEAL ABNORMALITIES IN AMETROPIC AMBLYOPIA

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This paper was awarded "The Emmie Russell Prize" for 1980.

Abstract
A study was performed on 90 children who clinically exhibited some form of foveal and/or macular abnormality. The most significant feature found was the high incidence of ametropia.

An attempt was made to correlate the clinically seen abnormalities of the fovea with:
1) The refractive state of the eye
2) The degree of visual reduction.

Key Words
Foveal abnormalities, ametropia, hypermetropia, astigmatism, foveal/macular hypoplasia, amblyopia.

INTRODUCTION

During a study performed by the author in 1979 on patients with bilateral eccentric fixation, certain specific abnormalities of the fovea were noted.

The foveal abnormalities seen in this study are divided into the following categories:

1) decreased or absent foveal reflex
2) poorly defined pigmentation in the macular area
3) abnormally small vessel-free area.

These categories were described by Curran and Robb[2] and Yoshizumi et al[3] in their discussions on foveal hypoplasia.

METHOD

A total of 90 children were found who exhibited one or more of the following characteristics in one or both eyes:

1) absent foveal reflex
2) diffuse, mottled, pale, poorly defined or elongated foveal reflex
3) displaced foveal reflex (ie. not in its normal central macular position)
4) absence of the pigmented macular area
5) poorly defined pigmentation in the macular area
6) small vessel-free area
7) nystagmus (either on observation or on visuscopy).

All these patients had been given a routine ophthalmological examination including refraction under cycloplegia, fundus check and a general orthoptic investigation including visuscopy. All patients had also at some stage been examined by the author.

Except for 2 patients who exhibited some degree of albinism, all the patients studied were considered to be grossly normal by the consultant ophthalmologist.

RESULTS

Sex Distribution – of the 90 cases, 46 (51%) were male and 44 (49%) were female.

Age Distribution – the age range of patients at first attendance was from 10 months to 15 years, the average age at the initial visit was 5.8 years.

Strabismus – some form of strabismus was present in 81 patients in the following proportions:

69 patients had a convergent squint (76.7%)
12 patients had a divergent squint (13.3%)
6 patients had a heterophoria only (6.7%)
3 patients had no demonstrable squint (3.3%)

Area of Fixation – as the foveal reflex was either absent, poorly defined or displaced in many cases, the fixation patterns were classified according to the following criteria:

1) "central" or "unsteady central" – around the central macular area – 69 eyes (38.3%)

2) "parafoveal" – between the central area and the side of the macula – 75 eyes (41.7%)
3) "macular" on the side of, but within the macular area – 21 eyes (11.7%)
4) "paramacular" – outside the macular area, but within the vessel-free area – 7 eyes (3.9%)
5) "greater than paramacular" – beyond the vessel-free area – 4 eyes (2.2%).

A further 4 eyes have not been classified into the above groups. These were the 2 albinoid patients who demonstrated none of the above landmarks, fixation being nystagmoid movements in the area where the peripheral blood vessels converged.

Refractive Error – the figures used in the following statistics are taken in terms of retinoscopy.

TABLE 1 – Spherical Error (in dioptres)

Amt. of error	No. of eyes	%
+6.00 and over	74	41.1
+2.00 to +5.75	80	44.4
–1.75 to +1.75	14	7.8
–2.00 to –5.75	7	3.9
–6.00 and over	5	2.8

Table 1 shows the distribution of general refractive error (using the spherical equivalent value). It can be seen that there is a significant number of eyes with a high degree of hypermetropia (41.1% with +6.00D and over) and only a very small number of eyes with high myopia (2.8% with –6.00D and over).

TABLE 2 – Astigmatism (in dioptres cylinder)

Amt. of error	No. of eyes	%
nil to 0.25	63	35.0
0.50 to 0.75	43	23.9
1.00 to 1.25	24	13.3
1.50 to 1.75	18	10.0
2.00 to 2.75	21	11.7
3.00 and over	11	6.1

Table 2 shows the distribution of astigmatism. It can be seen that there is a fairly high number of eyes in the higher degrees of astigmatism (18% with 2.00DC and over).

Visual Acuity – Fig. 1 shows the overall distribution of the best achieved visual acuity. Only 44 eyes (24.4%) had normal vision (6/6 or better). 55.6% of eyes had mildly reduced vision (6/9 – 6/12) showing that in these cases, the foveal abnormalities are unlikely to be an indication of a gross ocular anomaly.

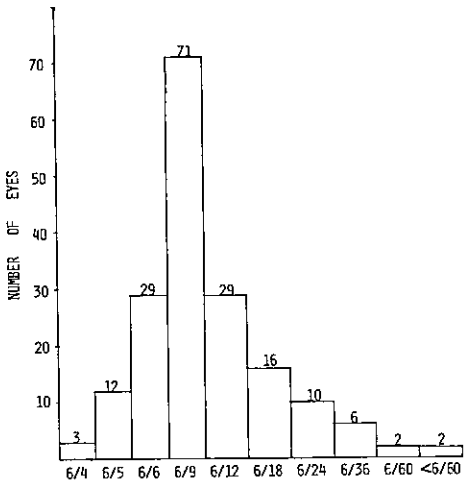

FIGURE 1

Visual Acuity (best achieved) vs. Refractive Error – Reduced visual acuity of 6/12 or worse was found to occur much more frequently in the higher refractive error groups (51.3%: +6.00D and over, 100%: –6.00D and over) and very infrequently in the lower refractive error group (21.4% between –1.75D and +1.75D). In the latter group, normal vision was more likely to be the rule (42.9%: 6/6 or better).

The picture was similar in the case of astigmatism, where above average acuity (6/5 or better) was only attained in the presence of low degrees of astigmatism (0.75DC or less) and the incidence of reduced acuity (6/9 or worse) increased with an increase in the degree of astigmatism (68%: 0.75DC or less, 100%: 3.00DC and over).

Types of Foveal Abnormality – A wide variety of abnormalities was found, sometimes only one area being affected and sometimes a combination of areas. The most common abnormalities were those involving the fovea itself (50%).

Visual Acuity vs. Foveal Abnormalities – The occurence of foveal abnormalities was higher in the presence of reduced acuity (92% with 6/9 - 6/12) and lower in the above average vision group (53.3% with 6/5 or better). There was however no further increase in the incidence of foveal abnormalities as the visual acuity decreased. There was no significant difference in the incidence of foveal abnormalities in the dominant and non-dominant eye.

Refractive Error vs. Foveal Abnormalities – A correlation was found between the amount of refractive error (spherical error) and the presence

of foveal abnormalities; the highest incidence being in the higher refractive error groups (89.2%: +6.00D and over, 80%: –6.00D and over) and the lowest incidence in the lower refractive error group (57.1% between –1.75D and +1.75D).

A similar correlation was found in the case of astigmatism (82.9%: 0.75DC and less, 90.9%: 3.00DC and over). It has also been found that astigmatic eyes sometimes demonstrate an elongated foveal reflex as found at ophthalmoscopy rather than the usual pinpoint shape. A similar correlation also exists in this case (10.4%: 0.75DC and less, 27.3%: 3.00DC and over).

DISCUSSION

Helveston and von Noorden[4] conducted a study on the appearance of the fovea in strabismic amblyopes. They compared the foveal appearance of the amblyopic eye to that of the other so-called "normal" eye, in the same individual. They found the incidence of foveal abnormalities to be almost the same in both eyes. However, it has been found that the dominant or "normal" eye of an amblyope may not indeed be the same as a normal eye of a normal subject, where some degree of amblyopia and eccentric fixation may be demonstrated even in the fixing eye.[5 6 7] This was also demonstrated in this study where 64 patients (71.1%) had foveal abnormalities in both eyes.

Albinism – A common feature of the albinoid eye is that the macular area is not fully developed and there is absence of the foveal reflex. Mann[8] states that in foetal development pigmentation of the eye appears just before the differentiation of the retinal layers, and may also determine this. In the absence of pigmentation, it can follow that retinal development may be delayed and never reach its final stage ie. the formation of the fovea. Thus reduced visual acuity would occur.

This feature may be evident in the two patients in this survey who exhibited albinism, where the macular and foveal areas were absent and substandard vision was found.

Refractive Error –

Hypermetropia – In cases of macular hypoplasia, the retina in the region of the posterior pole fails to develop fully, remaining at a stage of differentiation similar to that of a 6th month foetus. These patients usually demonstrate gross amblyopia or even blindness.[1] Duke-Elder[1] and Mann[8] both state that a similar condition or intermediate stages between hypoplasia and full differentiation of the macular area may exist in highly hypermetropic eyes. Duke-Elder[9] also states that the hypermetropic eye is typically small and as such could therefore be considered an underdeveloped eye. If this is the case, then it could follow that the hypermetropic eye might demonstrate a relatively more frequent occurence of developmental foveal abnormalities.

In this present study, it can be seen that a significant percentage of eyes have a high degree of hypermetropia. 35.7% have an error of +7.00D and over. The significance of this figure can be seen when compared to a survey by Broekema[9] where only 4.3% of hypermetropes had an error of +7.00D to +10.00D. Also there is a much higher incidence of foveal abnormalities in the most hypermetropic group than in the lower refractive error group (89.2%: 57.1%).

Duke-Elder[9] states that the visual deficiency in marked hypermetropia may be due in part to a lack of retinal development. Reduced acuity of 6/12 or worse was present in 51.3% of eyes in the most hypermetropic group compared to only 20% of eyes in the next group (+2.00D to +5.75D).

Astigmatism – It is interesting to compare the incidence of astigmatism found in this study to a survey by Cavara et al[9]. The incidence in lower degrees (less than 1.00DC) is similar in the two surveys – 58.9% here compared to 65.5% (Cavara); however, a different picture is seen in the higher degrees (2.00DC and over) - 17.8% compared to only 9.5%. As previously mentioned, in the higher degrees of astigmatism, there is a higher incidence of both amblyopia and foveal abnormalities.

Ikeda and co-workers[10 11] have found that amblyopia can arise as a result of lack of clearly focused image stimulation of the central retinal ganglion cells during early development. In the case of high hypermetropia and astigmatism there is no position where an object of regard is seen clearly and permanent reduction in acuity may result.

CONCLUSION

The most significant finding in this study is the high incidence of ametropia, especially hypermetropia and astigmatism in children with foveal abnormalities.

The markedly hypermetropic or astigmatic eye may be one that is developmentally deformed and as such could then have a higher incidence of

developmental anomalies of the foveal and macular areas, as these are the last of the retinal areas to fully differentiate.

To possibly determine the effect of these abnormalities on any associated amblyopia, one could perform a foveal electro-retinogram (ERG) to establish if there is some depression of function at the retinal level itself.

The fact that a high percentage of the patients in this study do not have gross amblyopia, as would be expected in true foveal hypoplasia, indicates that in these cases the foveal abnormalities are not the main aetiological factor of the reduced vision; but these abnormalities may be associated with some other causative factor eg. hypermetropia or astigmatism.

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Ed's. note:

The role of unilateral squint and anisometropia in the genesis of amblyopia and the evidence of binocular interaction at cortical level has not been considered in this paper. Useful reviews are those by Gunter K. von Noorden "Current Concepts of Amblyopia" in Orthoptics Past, Present, Future, 1976. Stratton Intercontinental Book Corporation New York p37, and Hisako Ikeda "Visual Acuity, its Development and Amblyopia" August 1980 Journal of the Royal Society of Medicine, 73, 546.

AN OPHTHALMOLOGIST REVIEWS LEARNING DISABILITIES

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Abstract
There is a fascinating mixture of fact and fiction in the confusing claims and counter claims of those managing patients with learning disabilities requires some elucidation.

Recent electrophysiological evidence shows that patients with specific developmental dyslexia have definite evidence of brain damage. This will perhaps alter acceptance of reported abilities to improve reading with visual training or orthoptic procedures. Statistical reappraisal of some claims should be made before they can be accepted.

Key Words
Specific learning dyslexia, learning disabilities, visual training.

INTRODUCTION

Ophthalmic literature has largely ignored this subject. Most ophthalmologists have considered the problem of learning disabilities to be a problem for remedial teachers. This hiatus in the literature has been filled by other authors so that by today many claims have been made concerning the efficiency of forms of therapy (e.g. visual training, exercises, spectacles, occlusion) without scientific evidence. Few rebuttals have appeared concerning these various claims. This has given an air of respectability to authors whose theories have been published as proven fact. These authors have gained further respectability by the "greybeard" rule and frequently claim that proof of their theory appeared in a previous article.

CLASSIFICATION OF LEARNING DISABILITIES

The failure of authors to classify fully the problem of learning disabilities has led to confusion on a grand scale. For those who require a simple, practical classification the Florida classification of Cassin[1] which Shayne Brown[2] introduced to the Australian literature can be reommended viz.

1. Specific developmental dyslexia
2. Minimal brain damage
3. Brian damaged
4. Environment
5. Cultural
6. Mixed

Each of these classes requires a different method of therapy. The role of any form of visual therapy in these groups of patients is difficult to defend. The role of "visual therapy" will be considered in more detail.

1. Role of Vision in Learning Disability

Goldberg[3] states "There is no relationship between peripheral visual ability and reading problems". Poor vision may give slow reading because of difficulty identifying details but it will not give reversals. The presence of a visual defect does not mean that visual inefficiency has caused the reading problem.

"Even small refractive errors may need correction" – Dunlop[4].

"Glasses were prescribed for 65% of the patients, 47% for reading" – Swanson[5].

No evidence is given in either article that the prescription of spectacles is of benefit. Indeed there is no evidence to be found that the prescription of spectacles is of benefit in these cases. Spectacles may give a false sense of security for correction will not improve perception. There is no peripheral ocular defect which produces dyslexia and associated learning disabilities. In particular ocular defects do not cause reversals of letters, words or numbers.

2. Ocular Movements

Cassin[1] & Brown[2] have found the incidence of

strabismus in learning disabilities to be similar to that of the normal population. This is in concurrence with other authors.

The finding of increased incidence of convergence insufficiency in children with learning disabilities may well be the effect of and not the cause of the learning disability.

Tracings of eye movements in cases of learning disabilities are popular. Faltering saccades and frequent reversals are related purely to comprehension which produces the movement and not the reverse.

3. Visual Training Techniques

The following peripheral visual abilities are claimed to be susceptible to training.

1. Ability to follow smoothly and accurately
2. Ability to fixate quickly and accurately with both eyes on series of fixed objects
3. Ability to change focus quickly, near to far and far to near
4. Ability to maintain prolonger near point activity. i.e. fixation, fusion, stereopsis, binocularity and mobility patterns.

No doubt many children can perform appropriate ocular gymnastics after prolonged bouts of training. Hand-eye co-ordination exercises may well improve hand-eye co-ordination but do not appear to improve reading or learning abilities.

Carlson & Greenspoor[6] – "We have studied much of the material provided by the optometrical developmental training approach and find it outdated, unsubstantiated, exoteric and pseudo scientific".

Goldberg[7] – "Those who advocate visual training for the treatment of learning disabilities have performed a questionable service to child educator and parent."

It bears repeating that peripheral factors are not causative in reading disability. i.e. refractive error, ocular muscle imbalance, binocularity or fusion are not causative.

4. Perception

Visual perception is the interpretation of the visual stimulus in light of previous experience. This act is performed at the angular gyrus. The frontal lobe understands the function of the object thereby developing the concept.

Recent investigation using electrophysiological techniques,[8,9] (V.E.P.) have demonstrated evidence of cortical dysfunction over the parietal region in patients with specific learning disability. Further investigation should prove the presence of brain damage. Impaired visual perception is not a cause of their reading problem but merely a symptom of impaired learning mechanism.

5. The Role of Dominance

Disturbance of right temporo-parietal region causes disturbance of spatial perception, loss of body awareness, loss of spatial relationship.

Disturbance of left temporo-parietal region causes disruption of language and associate thought processes.

It is interesting to note that injury to the left hemisphere in right handed persons causes aphasia in 97%.

Injury to right hemisphere in left handed persons – 59% aphasia. i.e. 41% have crossed laterality.

Note also that the transfer of dominance is rare after the age of 8 as evidenced by lack of improvement of aphasia.

The great majority of children with poor lateralisation do not have brain damage. Theories have abounded that poor lateralisation is a cause of reading disability. Instead it is a concomitant symptom of brain damage.

Brain[10] – "Failure to establish a dominant hemisphere is the result and not the cause of congential abnormalities of brain function expressed in disabilities of speech, reading and writing."

Much has been written concerning therapy to reverse crossed correspondence. But these articles (e.g. by Benton[11], Dunlop[12] etc) do not recognise that crossed correspondence is a symptom and not the disease.

The articles by Benton (dominant eye test) and Dunlop (the reference eye test) both claim marked improvement on reading ability with occlusion of the dominant or reference eye (Benton – greater than 75%.) Benton then treated a further series without patching and obtained 75% cure rate. Dunlop has not attempted a controlled trial. To date these articles have shown an "association" between crossed correspondence and reading difficulties but no "cause and effect" has been demonstrated. Any claims to improve reading say: "Occlusion plus remedial teaching plus psychological value of this study gives improvement". No study has shown that occlusion therapy is of value without combined remedial teaching. The number of patients treated with occlusion in Newcastle is of the order of many hundreds. Population show that these patients must include many of the

other categories of learning disability disorders besides true dyslexia. Yet occlusion could scarcely be suitable therapy for these. How can occlusion assist in cases of brain damage, environmental or cultural deficits.

EARLY DIAGNOSIS

Remediation is more effective if begun by the age of 3 years. The ophthalmologist and all other physicians should be aware of this. Attempted early diagnosis must be recommended to all physicians. Perhaps electrophysiological investigations may make this possible at an even earlier date.

CONCLUSION

This area is an excellent one for the charlatan. We must therefore take care to protect the public from prolonged expensive delaying therapies which may well result in postponement of beneficial remedial teaching. It is a field in which ophthalmologists must maintain a "watching brief" to prevent exploitation of children and parents because the issue of learning disabilities is a very emotional subject.

All ophthalmic personel should read "Conbined Statement of the American Academy of Paediatrics, Academy of Ophthalmology and Otolaryngology and American Association of Ophthalmology"[13] which is summarised:–

1. Learning difficulty requires a multidisciplinary approach.
2. No peripheral eye defect will produce dyslexia and associated learning difficulties.
3. Visual training or neurological organisational training including laterality and perceptual training is not supported with scientific evidence.
4. Glasses (except where normally clinically indicated) will not assist.
5. Dyslexia and learning difficulties are a problem of educational science.

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CONVERGENCE INSUFFICIENCY AND DUANE'S RETRACTION SYNDROME

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Abstract
A review of 37 cases of Duane's retraction syndrome revealed asthenopic symptoms in association with defective convergence in 22 cases. In some, symptoms were relieved by conventional convergence exercises. Evidence suggests that the presence of symptoms and the possibility of relieving them is often overlooked in such cases.

Key Words
Duane's retraction syndrome, convergence insufficiency.

The Stilling Turk Duane syndrome was first reported in 1887. Since being described by Duane in 1905 it has become better known as Duane's retraction syndrome.

Clinically the syndrome varies but characteristically the affected eye demonstrates an absence of abduction with widening of the palpebral fissure and perhaps some protruson of the globe on attempted abduction, and narrowing of the palpebral fissure with retraction of the globe on adduction, which may also be limited.

Frequently there may be either an upshoot or downshoot of the adducted eye. A manifest deviation may be present in the primary position, binocular single vision may be achieved by the use of a compensatory head posture. Convergence is often defective due to limited adduction. Not all the characteristics described by Duane are displayed by every patient.

The incidence and significance of the reduced convergence in these patients does not appear to have been studied, therefore the case records of 37 patients with Duane's retraction syndrome who have been seen at the Sydney Eye Hospital were examined to consider this and other associated features.

CONVERGENCE

Little has been reported in the literature concerning this feature. The usual concern of the examiner has been the limited eye movements with respect to the squint and cosmetic appearance. It was therefore very interesting that many patients first presented between the ages of 14 to 25 years and did so because they were experiencing symptoms of sore eyes and headaches related to close work. In this study almost 60% had a convergence near point more remote than 5 cms. It is therefore likely that these people had an associated convergence insufficiency, the significance of which may have been masked by the more obvious and interesting features of Duane's retraction syndrome.

All these patients had binocular single vision, either with or without a compensatory head posture, and may have had the potential to improve their convergence if treated with conventional exercises. Full convergence may have been an unrealistic expectation but some improvement may have been sufficient to relieve symptoms.

Seven patients were given conventional convergence exercises, of these two had a definite improvement, two failed to improve, and the remaining were lost to follow up.

ASSOCIATED FINDINGS

The syndrome affected females more than males, (58% : 42%). The left eye was more commonly affected than the right and there was one bilateral case.

Half of the cases had a compensatory head posture to achieve binocular single vision and of

these there was an almost equal distribution of eso and exo deviations in the primary position for near fixation. However the proportion of eso deviations increased in those without a compensatory head posture.

CONCLUSION

Of particular interest in this group was the large number which presented with poor convergence and associated asthenopic symptoms. This feature of the syndrome deserves special attention by the orthoptist and every effort should be made to relieve the symptoms. Conventional convergence treatment should not be overlooked as even a small improvement may relieve symptoms.

Australian Orthoptic Journal,
1980-81, Vol. 18

CASE REPORT: ALTERNATE DAY SQUINT TREATED WITH PRISMS WITHOUT THE NEED FOR SURGERY

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History:

A girl aged 9 years presented with an alternate day esotropia which was first seen at 3 years of age. Since that time the patient had been under continuous observation by different ophthalmologists and orthoptists without any change in the condition. Treatment had included glasses, occlusion and press-on prisms which only increased the angle of deviation but did not change the character of the squint.

Clinical Findings:

The child was first seen in the Sehschule Salzburg in August 1977 when she attended on a non-squinting day. The visual acuity was normal and equal.

The cover-test showed a small esophoria which measured 12△ for near and distance by prism covertest. On the synoptophore there was an angle of +6° with simultaneous foveal perception slides and a fusion range of 19°. There was a normal response to the after-image test.

Ocular movements showed a slight overaction of both inferior obliques. Four Worth's lights were seen for near and distance and there was a stereo acuity of 60" with the TNO test. Refraction under cyclopentolate revealed a low degree of hypermetropia which was corrected.

A further examination was carried out 5 days later on a squinting day when the angle of deviation measured 45△ base out by prism cover test and +24° on the synoptophore. Constant diplopia was present. The child was very disturbed by the cosmetic appearance and by the diplopia.

Treatment:

After discussion with the child and her parents it was decided to admit her to hospital for a few days observation. On the first day the angle measured 45△. Press-on prisms, 20△ base out on one lens and 25△ base out on the other, resulted in super-imposition of the diplopia. I invited the girl, who was very pleasant and cooperative, to be my assistant in the clinic, where she played with the younger children, switched on lights, stuck stamps on envelopes and so on. In the afternoon of the first day it was possible to reduce the prisms to a total of 30△ and the deviation remained compensated. The next day, which should have been a non-squinting day, the prisms were reduced to 10△. Fusion was possible, both in space and on the synoptophore. The next day, normally a squinting day, the prisms were reduced to 8△ and the deviation remained latent with binocular single vision but with an esotropia without the prisms.

After 4 days hospitalisation the girl was sent home wearing a total of 8△ base out. Two weeks later her eyes were straight without prisms and in another month the cover test showed a small esophoria both with and without the low hypermetropic correction. The diplopia had resolved and the squint had not been seen at home. Since that time the squint has not recurred and binocular single vision has been maintained.

Comment.

This case is unusual in that the alternate day squint had been present unchanged for 6 years. Other authors [1,2] have reported on cases in which the alternating pattern changed to an irregular cycle and eventually resulted in a constant deviation which required surgery.

The patient reported was the child of intelligent academic parents. The squint dictated the family's social life, all events were arranged for non-squinting days and when they coincided with squinting days they remained at home.

I believe there was a psychological problem and this probably lay behind the alternate day squint. By gaining the child's confidence and her friend-

ship it was possible to convince here that she could control the squint. Since she was been able to maintain binocular single vision she has become more confident and much happier.

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Australian Orthoptic Journal,
1980-81, Vol. 18

Case Report

CASE REPORT: SURGERY FOR CONVERGENCE INSUFFICIENCY

Helen Hawkeswood, D.O.B.A.

M.L. was referred aged 18 years, suffering from severe headaches and almost constant diplopia for near. She had a small exophoria of 3° for distance with 6° for convergence, a near point of 44 cm. and an exo deviation of 14△ – 18△ on the Maddox wing.

She was in her final year of school and was only able to continue studying by shutting her right eye. She had recently been prescribed her first pair of glasses, R $\frac{-3.50}{-0.50}$ 6/6 and L $^{-3.25}$ 6/6–4. With these she was having great difficulty as she could clear N/12 binocularly for only a short time before the print blurred.

At this stage she was visiting a psychiatrist who had her on some form of "relaxing" tablets.

The usual form of treatment was commenced, eliminating suppression at her angle and trying to improve her convergence. After some treatment, she showed little to no improvement, although with her glasses on she held at zero and her near point improved to 16 cm. at best but usually was 30 cms only. She converged on the machine to 10°.

She then decided to go overseas, having gained the Higher School Certificate, and on her return she sought further help which resulted in surgery, resection of the left medial rectus. A week later she was fusing at zero, converging to 30° and her convergence near point was 5 cms. A few visits later she was symptom free with a full convergence near point, and 50° of convergence on the synoptophore and a Maddox wing reading of exophoria 4△ to orthophoria.

I would like to express my thanks to Dr. G. Burfitt-Williams for allowing me to present these facts.

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CASE REPORT: MYASTHENIA GRAVIS PRESENTING FOLLOWING TRAUMA

Joseph A. Dalzell, Assoc. Dip.O.(Cumb.), D.O.B.A.

Abstract

A case of traumatically acquired inferior oblique palsy with exacerbation by a second injury is presented. The patient subsequently returns with ptosis and a left superior oblique palsy. Neurological tests confirm myasthenia gravis. The early ocular signs and symptoms of myasthenia gravis and its doubtful association with trauma are discussed.

Key Words

Diplopia, trauma, myasthenia gravis, ptosis.

Myasthenia gravis was first described by Thomas Willis in 1672 and later by Goldflam and Jolly.[1] The disease is characterised by weakness and fatigue of the striated (voluntary) muscle which usually manifests itself by first involving the extra-ocular muscles or other muscles innervated by the cranial nerves. Myasthenia gravis is considered to be a metabolic disorder consisting of a dysfunction at the myoneural junction, thus producing a disturbance in the normal mechanism of transmission of the nerve impulse from the nerve terminals to the muscle fibres.

The exact nature of the dysfunction has been the source of many investigations. Among those theories put forward at various stages are:

a) Insufficient formation of acetylcholine locally.
b) Abnormally rapid destruction of acetylcholine, perhaps due to excessive cholinesterase activity.
c) The presence of an abnormal curare-like substance that hampers access of normally formed acetylcholine to the muscle fibres.

However Merritt[2] in his text on neurology suggests myasthenia gravis is due to a defect of neuro-muscular transmissions caused by the presence of anti-bodies to the acetylcholine receptors. Such anti-bodies have been located at the myoneural junction by immunocytological studies. The exact cause of these anti-bodies is not known at this stage. Oda and others[3] also have detected anti-bodies to acetylcholine receptors in patients suffering from myasthenia gravis.

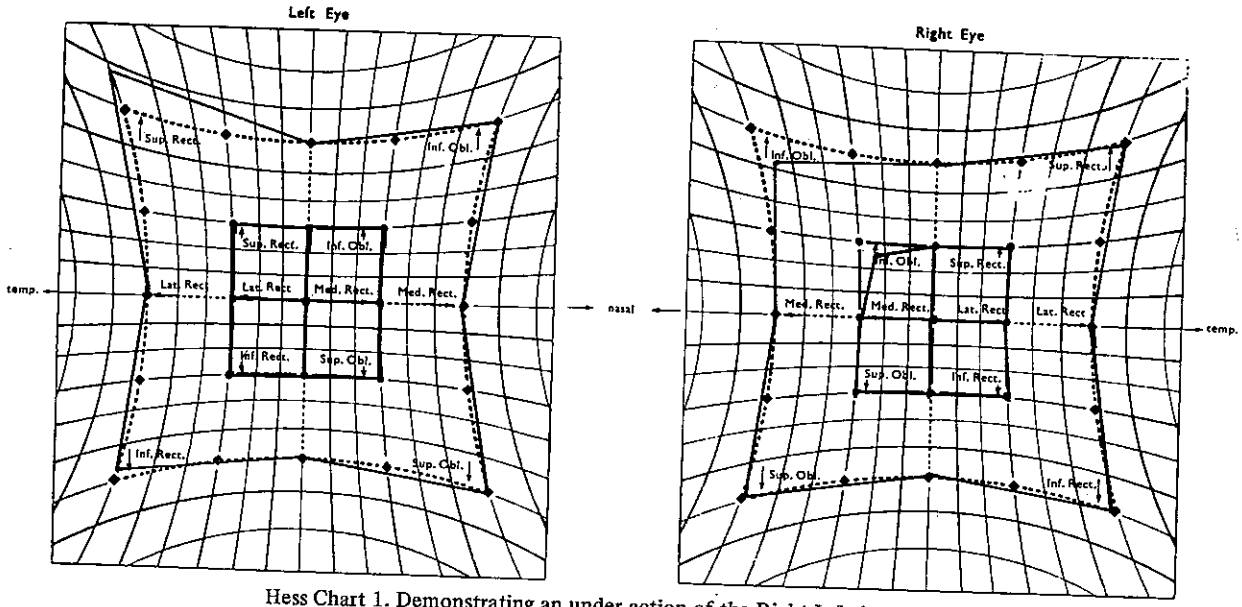
Drachman[3] has shown that the anti-bodies to the acetylcholine receptors block the receptor sites and accelerate their degeneration. Other recent investigations have also demonstrated:

a) Reduced amplitude of miniature end-plate potentials.
b) Electron microscope studies revealed that in patients suffering from myasthenia gravis some post-synaptic folds appeared abnormal. The nerve terminals appeared smaller than usual.
c) There were wider clefts between the nerve and the muscle.

Although Walsh[4] has observed myasthenia gravis in an individual who was involved in a motor vehicle accident he concludes such an association between trauma and the disease is doubtful; the follwoing case is presented as it exhibits the signs and symptoms of an early myasthenia developing after trauma. Consideration is also given to other possible precipitating factors.

A previously medically fit twenty-two year old clerk presented with a history of intermittent diplopia following a severe blow to the right orbit and temple during a football match some ten days previously. The patient noticed the diplopia was greatest on laevo-elevation.

Uncorrected visual acuity was 6/6 in each eye. Despite bruising around the right orbit there was orthophoria in the primary position. Cover test in laevo-elevation revealed a right hypotropia of eight prism dioptres. A Hess chart confirmed an under-action of his right inferior oblique (See Hess chart 1). The treating ophthalmologist advised that X-rays revealed no abnormality of the orbit.

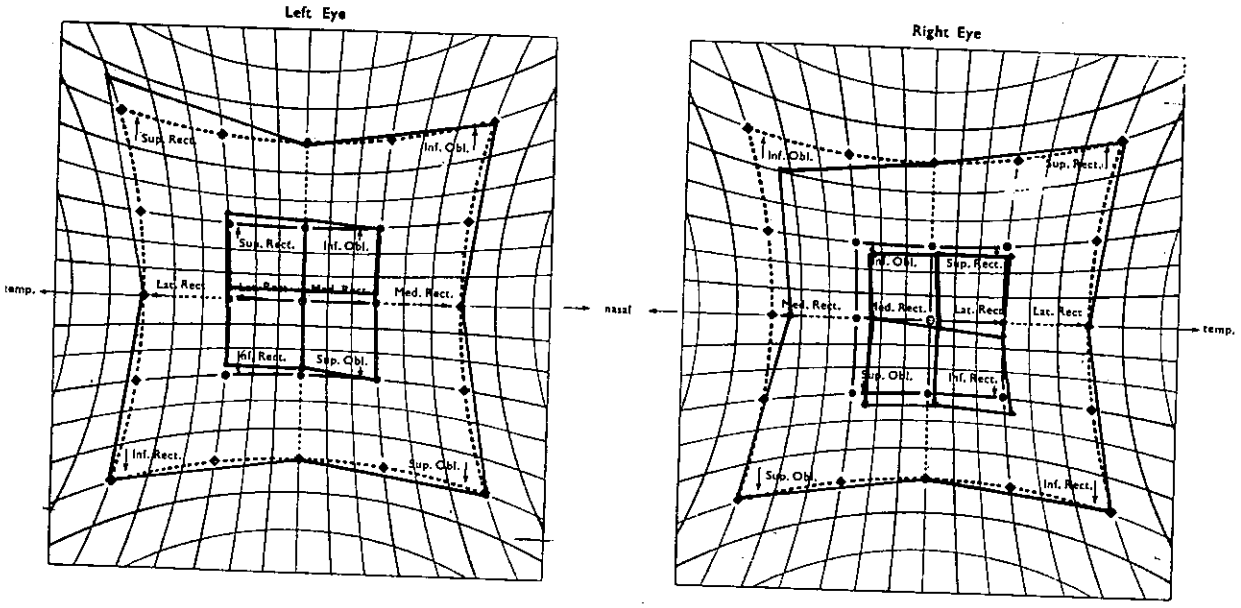


Hess Chart 1. Demonstrating an under action of the Right Inferior Oblique.

The patient was advised regarding occlusion and asked to return in one week.

Upon his second visit the patient stated there had been another severe blow to the same area, again during a football match. He was now complaining of constant, vertically separated diplopia, again greatest in laevo-elevation.

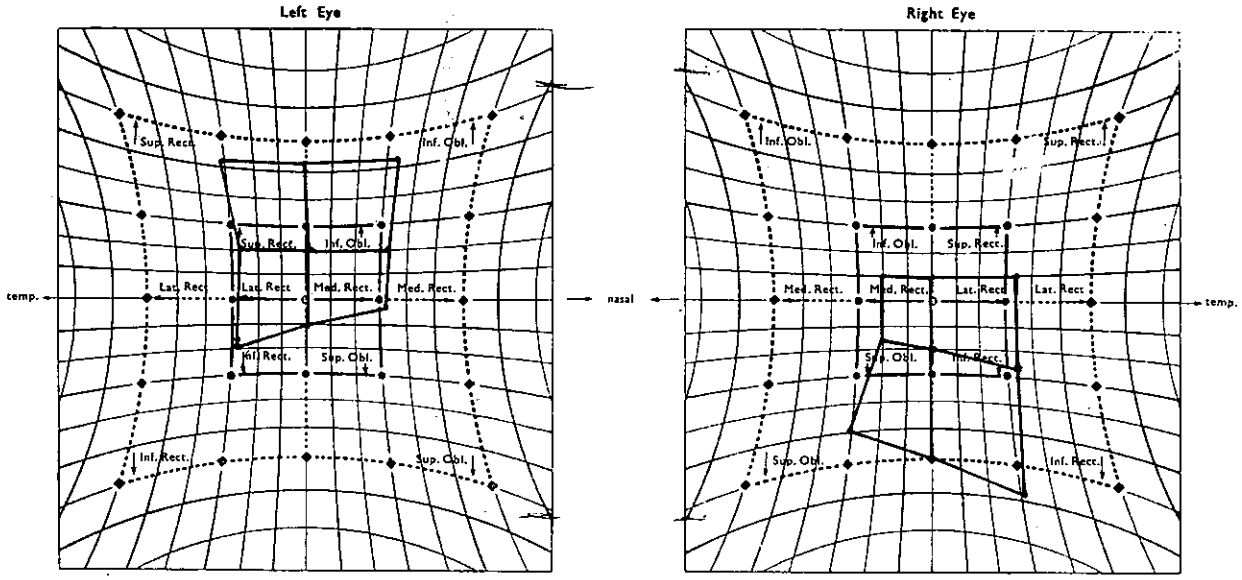
Cover test in the primary position revealed a right hypotropia of four prism dioptres, whilst in laevo-elevation there was a similar deviation of twelve prism dioptres. This again was confirmed by Hess chart. (See Hess chart 2.) Further X-rays revealed no abnormality.



Hess Chart 2. Demonstrating a small Right Hypotropia with an under action of the Right Inferior Oblique.

The treating ophthalmologist suggested that the injury previously sustained by the right inferior oblique had been exacerbated by the recent trauma. To permit the orbital swelling to decrease the patient was asked to return in one week. To overcome the diplopia he was instructed regarding alternate occlusion.

Upon his third visit the peri-orbital swelling had greatly decreased. The patient related that when not wearing the occlusion the diplopia was worse and the separation of the images was greatest in dextro-depression. Cover test revealed a marked increase in the size of the deviation. Examination of ocular motility showed a left superior oblique palsy which was confirmed by Hess chart (see Hess chart 3) and a Bielschowsky head tilt test. The treating ophthalmologist referred the patient to a consultant physician who arranged further neurological investigations including a tensilon test. These investigations were considered necessary in view of the increase in size of the deviation and the presence of a partial left ptosis which was also evident when the patient presented on the third visit.



Hess Chart 3. Demonstrating a Left Superior Oblique Palsy.

The neurological investigations confirmed the patient was suffering from myasthenia gravis.

He was placed on a course of mestinon (pyridostigmin), an anti-cholinesterase drug, and his condition improved. However the prognosis must remain guarded.

DISCUSSION

It is difficult to ascertain if the primary cause of the original weakness of the right inferior oblique was due to the trauma or was in actual fact an early myasthenic palsy precipitated by the physical exertion of the patient playing football.

In the light of the recent studies into the aetiology of myasthenia gravis which indicate the disease to be one of an auto-immune nature, I feel the comments made by Walsh and Hoyt[4] regarding the doubtful association between trauma and the onset of myasthenia gravis to be highly significant.

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Australian Orthoptic Journal,
1980-81, Vol. 18

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:

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OCULAR PROBLEMS IN HYPERKINETIC CHILDREN

Aiki Tohver and Sue Topham

Twenty hyperkinetic children with strabismus or related conditions were examined to establish the types of deviations present. Eleven had convergent deviations, six had divergent deviations, two had convergence insufficiency and one was an anisometropic amblyope. The proportion of divergent deviations appeared to be larger than that in a normal squinting population. Another feature noted was the variability in the angle of deviation in those with constant squint. A review of the possible aetiology of hyperkinesis is presented, along with the suggestions for the orthoptist in examing these patients.

OCULAR DISTURBANCES IN SPINA BIFIDA

Jenny Walsh

The types of ocular disorders in fifty four cases of spina bifida with an age range of six months to nineteen years were examined. Results show a high incidence of strabismus (35%) and nystagmus (29%) and in cases with hydrocephalus results suggest a fairly even distribution of exo and eso deviations. This indicates the need for a full ocular examination of these patients, particularly looking for strabismus and nystagmus, as part of a total management plan.

VISUAL FUNCTIONS IN INTELLECTUALLY HANDICAPPED CHILDREN

Georgina McLoughlin

Sixty children from Opportunity "A" classes (slow learners) were screened for the following conditions: significant refractive error, decreased visual acuity, strabismus, heterophoria, defective stereoacuity, eccentric fixation, nystagmus, defective colour vision, defective convergence, defective accommodation and crossed dominance. It was found that one or more of these problems was found in 58% of the children, which is significantly higher than in the normal population. Since the classification of these children into special classes is made by tests which rely on vision, it is suggested that the visual defects, many of which had not previously been detected, may have affected the child's performance in such tests.

ORTHOPTIC INVESTIGATION IN THE VISUALLY HANDICAPPED CHILD

Susan Landers

A method of orthoptic investigation for the visually handicapped child is presented which stresses the importance of this assessment in the educational and developmental training programmes. Suggestions are also given regarding the presentation of these findings to other therapists. Two case studies are included as illustrations.

THE EFFECT OF AGE ON STEREOACUITY

Elizabeth Dunmall

300 subjects were examined, ranging in age from eight years to eighty-nine years, with the Titmus stereotest. All patients were orthophoric or had a small to moderate heterophoria, near visual acuity of N5 (corrected if necessary) and good convergence.

The results indicate that stereoacuity increases with age until 25 – 45 years of age where the mean acuity is 40 seconds of arc, then starts to decline until 56 – 65 years of age where a marked reduction in stereoacuity begins. The mean acuity for those aged 65 and over is 80 seconds of arc.

THE CHANGE IN COLOUR PERCEPTION WITH AGE

Lorraine Peake

The yellowing of the optic media with age causes an absorption of the short wavelength (blue) light and therefore should decrease colour sensitivity in the blue spectrum.

The Farnsworth-Munsell 100 Hue test was used on varying age groups and results showed the blue-green area to be discriminated the least accurately. This discrimination decreases with age and mental and physical health. The red-yellow area of the spectrum is the least affected.

OCULAR CONDITIONS IN TWINS

Linda Cambridge

A study of forty eight pairs of twins, of which thirty four pairs were monozygotic and fourteen were dizygotic, revealed a high frequency of intrapair similarity of ocular conditions in monozygotic twins and discordance in dizygotic twins. The nature and incidence of these ocular conditions is analysed.

THE DEVELOPMENT OF VISUAL MOTOR REFLEXES IN INFANTS

Cathy Hill

Seventy eight babies under the age of six months were examined to investigate the normal development of the visual motor reflexes. Convergency, horizontal and vertical saccades, and horizontal and vertical optokinetic nystagmus were tested. It was found that the development of vertical movements lagged behind that of horizontal movements, but by twelve weeks of age all movements could be demonstrated.

THE EFFECTS OF DIPLOPIA AND REDUCED VISION ON CONSTRUCTIONAL APRAXIA TESTS

Carolyn Long

Simulated diplopia and reduced vision were shown to give misleading results in constructional apraxia tests. Although constructional apraxia may be diagnosed on other than visual tests, results illustrated the necessity for visual consideration in the overall diagnosis and the therapeutic management of a patient suspected of having constructional apraxia.

THE CORRECTIVE FUSIONAL RESPONSE IN INFANTS

Odjana Sljokic

The significance of using different strengths (10△ or 15△), and types, (loose or Fresnel) of prisms is assessed when testing for the presence of motor fusion in infants. The age at which a response can first be expected is also investigated.

One hundred subjects were tested, from the age of of one week to three years. The tests employed and the results gained are discussed.

The study showed that the 15△ loose prism placed base out before an infant's eye could elicit the greatest response in all age groups examined. The earliest age at which this could be demonstrated was three months.

THE 4△ PRISM TEST AS A TEST FOR REFERENCE EYE

Kim Dempster

Three tests to evaluate the reference eye were investigated. The comparitive responses to the 4△ test when performed to either eye, were compared with other tests to evaluate the reference eye.

It was found that there was a strong correlation between the responses to the 4△ test and to the mirror reference eye test (described). It is suggested therefore, that the 4△ test may be useful in determining ocular laterality.

SIMULTANEOUS AND ALTERNATE PRISM COVER TESTS

Grant Ormerod

Thirty subjects with a small esotropia of 15Δ or less at six meters, were measured using both the simultaneous and alternate prism cover test. Results showed that a superimposed latent deviation was present in 87% at six meters, and 97% at thirty three centimeters. The mean latent component was 4.5Δ at six meters and 7Δ at thirty three centimeters. On testing binocular vision it was also found that subjects with a manifest angle of 8Δ or more were unlikely to show a binocular response when testing in free space at that distance.

INVESTIGATION OF LATERAL GAZE INCOMITANCE IN INTERMITTENT EXOTROPIA

Loretta Joice

Fifty eight subjects with intermittent exotropia were examined to demonstrate the incidence lateral gaze incomitance and emphasise the necessity to modify surgical procedures if it is present. Bilateral lateral gaze incomitance was present in 48.3% of subjects, unilateral incomitance was found in 32.8% and only 15.5% of subjects were laterally concomitant. The possible reasons for this incomitance are examined, along with its implications for surgical management.

AN ALTERNATIVE METHOD OF TESTING SACCADES FOR THE ORTHOPTIST

Gemma Morrow

A description is given of a method for testing saccadic eye movements in all patients with any ocular disturbance. An interpretation of the factors seen while observing these movements was made, considering the amplitude, velocity, type of movement and fixation ability. All findings were recorded, normal or abnormal. The results were varied and suggest that further research is necessary for documentation of the features of saccadic movements for orthoptists to use in the clinical situation.

THE CAM STIMULATOR AS AN ALTERNATIVE METHOD OF SUPPRESSION TREATMENT FOR CONVERGENCE INSUFFICIENCY PATIENTS

Anne Fitzgerald

The Cam Stimulator was used to treat suppression in convergency insufficiency patients. The patients were divided into three groups according to the method of treatment used (Cam stimulator, conventional methods, or monocular reading). In all groups suppression was graded and the length of time of treatment was recorded. If any suppression was still evident when the patient was discharged this was also recorded.

The results showed that the Cam stimulator was successful in suppression treatment and it worked more quickly than the conventional methods of treatment.

FACTORS INFLUENCING SUCCESSFUL PATCHING

Linda Willis

Through a questionnaire to children wearing a patch and their parents, a series of factors have been considered to discover which play the main part in successful patch wearing. It established that poor vision with a patch on is not the only reason for inadequate wearing.

The understanding of the child and parent as to the reason for the patch appeared to be an important feature of successful wearing.

COLOUR VISION AND NON-CENTRAL FIXATION

Jeanine Navin

Results are reported of a survey of colour vision discrimination in ninety-four patients with eccentric fixation. Colour vision was measured with the Farnsworth Munsell 100 Hue colour vision test. The results suggest that accuracy of performance appears to be related to age and visual acuity rather than fixation.

From these findings it is now debatable whether the red filter used in the treatment of eccentric fixation has any theoretical basis and it may be that any results obtained by this form of treatment may be related to the use of occlusion with detailed close work and encouragement.

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(See also Vancouver Agreement*)

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* Refer Med. J. Aust. 1979:2 (August 25): 182-6

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