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* Presented at the 36th Annual Scientific Meeting of the Orthoptic Association of Australia, Sydney, October 1979

** Awarded "The Emmie Russell Prize" for 1979

EDITORIAL

This introduces a year's hard part-time work by some 30 or 40 people: – contributors, their colleagues, and the editors.

According to our various interests and opportunities we have considered, debated, and recorded as best we can the facts we observed, the problems, solutions, and questions we encountered. We have sought to present them so that you, the readers, may readily grasp, share, comprehend, and answer them.

The editors' aims are two. One is to select the contributions that will be most interesting or useful. The second is to ensure that any author's meaning will be clear to most readers.

The writer's own absorption in his topic often makes it difficult for him to judge which aspects of it are easy and which are hard for readers to understand. Words, while he writes them, are apt to suggest ideas which divert him, for the moment, from an intended logical presentation. The stimulus of a visible audience is lacking. The editor should be available as a preliminary audience.

If he is to help the writer, the editor must approach each contribution humbly, studying the whole before the parts. If all goes well, this leads to a mind-to-mind encounter wherein causes of obscurity are discussed and overcome. Such encounters make us intensely aware of diversity of approach, assumptions, vocabulary and knowledge; they confirm a common purpose, a common sense of responsibility, a common zeal for learning.

Now, readers, it is time for your minds to make contact with ours. We hope you will share our delight in diversity, and will appreciate the essential singleness of purpose, and that in due course you will offer, in writing, the fruits of your own experience to update ours.

Diana Craig

Miss Emmie Russell presents Miss Sue Cort (left), winner of "The Emmie Russell Prize" for 1979, with her award watched by the President, Mrs Patricia Dunlop (right), at the 36th Annual Scientific Meeting of the Orthoptic Association of Australia, Sydney, October 1979.

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ORTHOPTIC ASSOCIATION OF AUSTRALIA
36th ANNUAL CONGRESS
SYDNEY
OCTOBER 1979

Presidential Address

We are indeed honoured to have Mr. Kevin Stewart, the N.S.W. Minister of Health with us today and on behalf of the Orthoptic Association of Australia I would like to thank him for opening the 36th Annual conference of our Association.

I should also like to welcome our many distinguished guests, our visitors from home and abroad, our own members from the various states of the Commonwealth. Many have travelled long distances to join us here in Sydney.

This 36th Annual Orthoptic Conference coincides with the International Year of the Child. We, as orthoptists are keenly aware of the principles declared and adopted at the United Nations General Assembly in 1959 on the rights and freedoms which every child should enjoy.

Our work in the profession of orthoptics involves us very much in the world of the child, so that friendship, understanding and tolerance are already a part of our daily commitment.

No orthoptist needs to be reminded that the possibility of a good functional result in a case of childhood strabismus declines rapidly where that child has been neglected through lack of care by responsible adults. Our aim should be, not only to care for the child but also to educate adults so that the ultimate result will benefit the child.

It is fitting that we associate ourselves with the International Year of the Child and its concepts of understanding, tolerance and friendship.

1979 marked the 4th International Orthoptic Congress held in Berne, Switzerland. Many Australian orthoptists attended with a total representation of 34 including ophthalmologists. Five papers were read by Australians and the O.P.S.M. Trachoma Film was shown also. Shayne Brown and Anne Marie Mahoney represent us on various International Orthoptic Association Committees. We are pleased that the Committee of Management of the International Orthoptic Association has accepted our invitation to hold their next Council and Annual General Meetings here in Australia in November 1980. As our Association is a full member of the International Orthoptic Association, all our members are encouraged and entitled to attend the International A.G.M. next year.

The Orthoptic Association of Australia grows each year with the influx of larger groups graduating from our two training schools and the fact that more orthoptists tend to stay in the work force after marriage or return to it later on. Our full members have increased from 123 in 1974 to 220 in 1979. Twenty years ago 15 orthoptists attended the annual conference – today we have a registration of 145.

Since the approval of the 3 year Diploma course in Orthoptics in 1978, orthoptists enjoy recognition as one of the para-medical professions. Orthoptists are ready to take a responsible place on any recognised committee for the purpose of improving eye health care in Australia.

It is particularly pleasing to have Mr.Kevin Stewart (N.S.W. Minister of Health) perform our opening ceremony and support our Association in this way. Let us look forward to a new era where orthoptists are fully recognised by Government and Community.

Those of us who are involved with the training of orthoptists in Australia must be aware of the types of employment available to graduates. However, let us not orientate the training too far in the technical area lest we overlook the professional side of orthoptics:– the *diagnosis, prognosis* and *therapeutics* of ocular muscle imbalance and binocular vision defects. The reciprocity with the British Orthoptic Society's Diploma which the Australian qualification now enjoys is something we should not take lightly and must strive to maintain in our professional standards.

In the 1979 Queen's Birthday Honours, Miss Patricia Lance was honoured with Membership of the Order of the British Empire for her services to orthoptics. I am sure you would all like to join me in congratulating her on this high honour to herself and to our profession.

Recently there has been much interest in the new treatment of amblyopia developed by the

Cambridge research/clinical team of Watson, Hess, Campbell and Banks and many of you will have read articles and reports of it.

We are indeed fortunate to have Miss Ruth Banks here as our guest speaker at this conference in Sydney. Some Australian orthoptists have been using these techniques and we hope to have a stimulating and informative session on this subject later this week.

We are also delighted to welcome Miss Mary Wesson (U.K.) and Miss Frances Williams (Canada) who will each present a paper. Mary Wesson is Treasurer of the International Orthoptic Association and is also an Honorary member of the Australian Orthoptic Association.

The organising committee for this 36th Annual Conference under the able chairmanship of Janette Yap has worked hard to prepare an interesting scientific and an enjoyable social programme for you. We trust you will find something of interest, something to learn and pleasant company during the coming week in Sydney.

Patricia Dunlop, D.B.O. (D.) (Lond.)
President, Orthoptic Association
of Australia, 1978–1979

PATRON'S ADDRESS

Madam President – four years ago you asked me to be Patron of your Sydney Orthoptic Congress, a fact regrettably that I had almost forgotten until I found a copy of the speech that I had given at that time. I tried on that occasion to look into a crystal ball as to the future of orthoptics. You were at the crossroads, you had college problems, curriculum problems, community problems, identity problems, not forgetting the orthoptic problems.

I think that the last four years has probably been the most significant in the history of orthoptics in Australia. You are today, four years later, confidently, aggressively and solidly established in one of the leading institutes of health science in the world. You have an established three year course. You are Associate Members of the Royal Australian College of Ophthalmologists and your work in the community field is now well recognised.

I consider the very presence of Mr. Stewart, the Minister for Health, at your opening today, whilst it might not quite give the Royal stamp of approval, is indeed a great honour for the Orthoptic Association of Australia. Perhaps political recognition these days is as important as professional and community recognition.

With all this success where do you go from here? Perhaps, Madam President, you are once again at the crossroads. I suggest that if you are an enthusiastic profession you are always at a crossroad. You are now professionally established and it is time to look at the quality of orthoptics because I believe the future of medicine and orthoptics depends on being able to deliver quality. My challenge to you for the future four years is this, your President may like what I am going to say because I think it is from her that I have learnt it, but some of you perhaps will not like it. It is the following:- I think it is very difficult to see any great advance in orthoptics over the next four years unless we greatly improve our understanding of basic sciences and neuro-physiological processes.

Your President has clearly proved this by the recent paper she gave at the International Orthoptic Congress in Berne. That does not mean that you are not practising excellent orthoptics. I know you are, within the bounds of your present knowledge. Our knowledge and understanding and conceptualisation of binocular vision is really just developing. I think, with that knowledge, Clinical orthoptics will really take off. Forty years ago Chavasse said "So long as a squint is present, the child pays with its sight for every day's delay whoever treats it. The child has a moral right to instant investigation and treatment. It is the only way." I cannot improve on those words. I know with an increasing knowledge of neuro-physiology and binocular vision that the child is going to get even better treatment in the future.

Madam President, you have done me a great personal honour in asking me to be your Patron. I sincerely hope your Congress will have all the success it deserves.

Geoffrey C. Hipwell F.R.A.C.O., F.R.C.S.

CONTRAST SENSITIVITY – A MORE REALISTIC MEASURE OF VISUAL FUNCTION

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Presented in Sydney, November, 1978

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Abstract
Terms used in the study of spatial contrast sensitivity are defined and the basic neurophysiology related to the Cam Vision Stimulator is briefly mentioned. An outline of the development of the concept of modulation transfer function and an explanation of its practical value in comparison with visual acuity tests includes discussion on the use of Arden Gratings.

The advent of the Cam Vision Stimulator and the Arden Gratings has brought a new terminology to the practising orthoptist. It is important that she knows exactly what is meant by "spatial contrast", "spatial frequency", "contrast sensitivity" and the like and how such terms are used to describe visual function. This paper will attempt to explain the basis of the new tests, and the reasons why they are so superior to the Snellen visual acuity and similar tests (E, Landolt C. Sheridan-Gardner etc.)[1]

Definitions.

A *Grating* is a regular pattern of light and dark bars, usually presented clinically as vertical bands.

A *Square Wave* grating denotes a pattern of light and dark bands where the change from light areas to dark, and from dark to light, is instantaneous. (Figure 1, D)

A *Sine Wave* grating is a pattern of light and dark bands in which the change in brightness follows the path of a sine wave. This results in a continuous change so that the brightness is constantly altering throughout the whole cycle from light to dark and dark to light. (Figure 1, A,B,C)

Spatial frequency is defined as the number of complete cycles of change from dark to light and back, in a grating pattern, per degree of visual angle: (therefore, for any given grating, the spatial frequency varies with varying viewing distances).

Spatial Contrast expresses the difference between the light and dark parts of the pattern. If the pattern varied between pure black and white the contrast is said to be 1.0. If the bands varied from dark grey to light grey the spatial contrast might be, say 0.3. At some frequencies humans can detect spatial contrast of less than 0.01. (Some authors use "percentage contrast" where the above figures are multiplied by 100).[2]

Contrast sensitivity expresses the ability of the visual system to detect spatial contrast. As the contrast of a test screen is gradually raised from zero, (i.e. uniform illumination), the level of contrast at which the light and dark pattern of the frequency being tested is first detected is termed the threshold contrast for that frequency. Contrast sensitivity is expressed as the reciprocal of the spatial contrast at which the pattern is first detected. Thus if the threshold contrast was 0.01, the contrast sensitivity would be 100.

The Contrast Sensitivity Function is a *curve* showing the contrast sensitivity at each spatial frequency over a range, usually from 0.1 to 40 cycles per degree in humans. (30 cycles is approximately equivalent to 6/6 in Snellen's type tests. Human vision is most sensitive to spatial frequencies of around 3 cycles per degree, not 30 cycles per degree.) (See Figure 2)

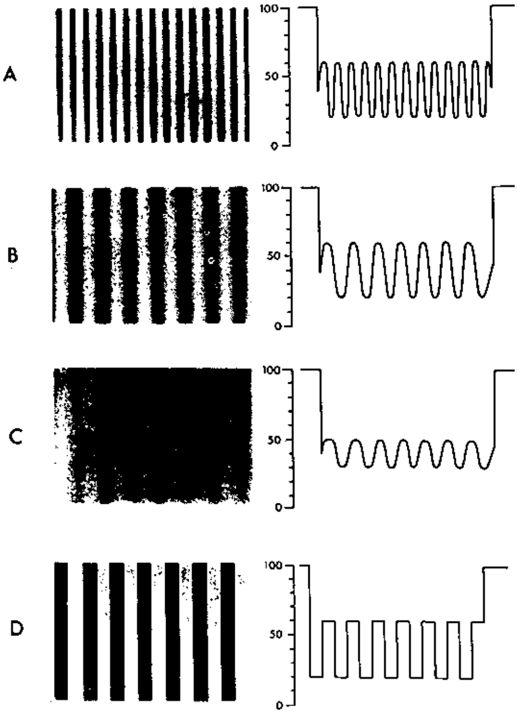

FIGURE 1
A,B & C are sine wave gratings; D is a square wave grating. The spatial frequencies of gratings B, C & D are equal but that of A is higher. The contrast of gratings A, B & D is equal but that of C is lower. All four gratings have the same average brightness overall. Humans are most sensitive to spatial frequencies of about 3 cycles per degree which corresponds to grating A, viewed at 85 cm (From G. B. Arden, B.J.O.[6])

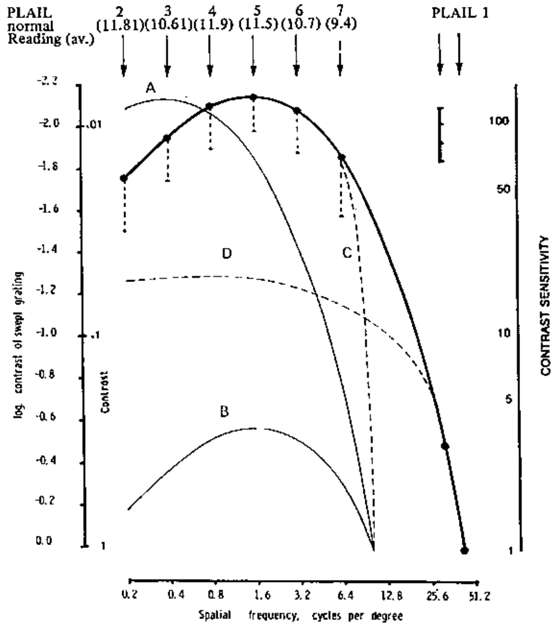

FIGURE 2
The heavy line is the normal human contrast sensitivity curve. The arrows above show (2-7) the points on the curve tested by the 6 Arden gratings. Curves A & B show two different types of amblyopia in whom visual acuity is equally depressed, but obviously B has a much more serious loss of visual function. Curve C shows high frequency loss which often occurs with refractive errors. D shows the curve of a patient with normal visual acuity but severe qualitative loss of vision due to depressed low spatial frequency sensitivity. (Modified from G. B. Arden, B.J.O.[6])

In a particular individual the curve might show overall depression; or loss of sensitivity over a limited range of frequencies e.g. high frequency loss, or low frequency loss, just like an audiogram.

Just as we can define the ear's sensitivity to various sound frequencies (cycles per second or Hertz) with an audiogram, we can define the eye's performance with a "visuogram" or a "contrast sensitivity function". This will record the eye's sensitivity to various spatial frequencies (cycles per degree of visual angle) as a reciprocal of a threhold contrast, for each frequency. The words "contrast sensitivity function" simply mean that the visual system is tested at each of a significant number of spatial frequencies for its ability to detect contrast.

The amazing thing is that this is apparently just what the visual system actually does. It analyses the visible world in terms of the relative size (spatial frequency) of adjoining areas of differing brightness (contrast) and the orientation of the lines of contact between those areas (from 0° to 180° — not just vertical bars). The visual cortex is arranged in fine layers (or lamina) like a layered cake. In each lamina the cells are all responsive to a specific spatial frequency. At the same time the cortex is arranged in columns, from the surface to the deeper layers; all the cells of each column have the same orientation sensitivity.

So a needle penetrating vertically (to the surface of the brain) will meet cells which, at all depths, are all sensitive to the same orientation of spatial stimuli; but as it goes deeper the cells have spatial frequency requirements changing from lamina to lamina. A needle parallel to the surface would meet cells of the same spatial frequency requirement but differing in orientation sensitivity from column to column.[3] This is the way the brain structure is organised to analyse form and contrast. On this basis Fergus Campbell[4] designed the Cam Stimulator to activate cells of all types whatever their spatial frequency or orientation sensitivities might be.

EVOLUTION OF CONCEPT

The main impetus for the "new" techniques began in World War II.

Just as the practice of orthoptics itself received a great boost when the binocular vision of Allied airmen became a matter of vital importance, so the concept of spatial frequency analysis evolved from the wartime necessity to obtain better definition in aerial photographs of enemy targets.

Aerial camera lenses used to be assessed by their "resolving power" that is their maximum ability to show high contrast fine black lines on a white background as discrete and separate images. (This test is analogous to Snellen's visual acuity tests – and just as ineffectual). Costly new lenses were manufactured with very high resolving power, but their pictures often seemed harder to interpret than those of the old lenses. Experts argued heatedly about the relative advantages of their favourite lenses in esoteric terms similar to those used by modern art critics. There was no way of describing lens performance or the difference between various lenses in absolute terms.

But gradually it was realised that most of the detail in aerial photographs was of *low* contrast, often due to haze or fog, and overall interpretation often depended on recognition of the pattern of relatively large areas i.e. low spatial frequency.

So it became obvious that tests of high contrast fine lines (i.e. high spatial frequency) were not as important as tests of low contrast, over wide areas (i.e. low spatial frequency). This suggested the method of Fourier analysis where *all* possible spatial frequencies are recorded in terms of their relative contrast.

Fourier was a French mathematician who discovered that, no matter how complicated a pattern of energy input may be, it can be expressed accurately as the sum of a variety of sine waves at different frequencies and amplitude (contrasts). This is easy to understand with *sound* energy where the noise of a whole orchestra can be divided up into the component sound *frequencies* and *amplitudes* (loudness) of each instrument. The amplitude expresses the intensity of the sound energy (contrast from peak to zero of the sound wave).

Similarly, every picture can be accurately described in terms of the *spatial frequency* and relative light *intensity (contrast* of black and white) of its component features. Now we have a mathematical expression (a "function") to describe the picture. Any change in the picture changes ("modulates") the function. So if the picture is copied ("transferred") by a lens we can express the new copy as a *"modulation transfer function"*.

This accurate and comprehensive method of describing lens performance was universally adopted by lens makers in the 1940's, and later used to describe the "modulating" effect of various films, printing processes and accessory optical systems. It is the basis of the production and computer improvement of pictures taken in space by satellites and relayed to earth by radio transmission. These picture transmissions are often subject to considerable interference but the computer can calculate the degree of "modulation" in the radio "transfer" and correct the picture accordingly.

Some research workers used the term "modulation transfer function" (MTF) to describe visual system performance but most workers now use the term "spatial contrast sensitivity". Until recently clinical ophthalmology adhered to the old method of Snellen's high contrast, high frequency resolution tests – fine black letters on a white background, ignoring the now obvious need to describe low contrast and low frequency vision. Visual research laboratories changed to the new contrast sensitivity methods over fifteen years ago.[5]

PRACTICAL APPLICATION

All clinicians should now be aware that Snellen's and related tests describe not only a very small area of visual field (6/6 cover less than 1/10 of 1°) but also a very limited part of the less sensitive, extreme high frequency region of visual function, ignoring the wider areas of much more sensitive low frequency function.

There are a number of survival situations where foveal (Snellen's) vision is irrelevant but low contrast low frequency spatial sensitivity is supremely important: for example, flying an aircraft through hilly country in low cloud; rescue work in smoke or fog; or location of land marks or individuals in murky underwater environments. The authorities are very strict about visual standards (Snellen's) of pilots, firemen and police rescue staff. It is now obvious that they are testing the (often) irrelevant end of the spatial frequency function.

One reason for the delay in progress is that, until recently, suitable test patterns could only be produced on C.R.O.'s (cathode ray oscilloscopes – the original T.V. screens). With these instruments accurate mean lighting and contrast levels could be maintained for any spatial frequency grating and any contrast level, but the test procedures take too long for standard clinical application. The total amount of light coming from the test screen *must* be kept constant, whatever the contrast and whatever the frequency. The Arden book of gratings frees the clinician from the C.R.O. adjustments but accurate control of lighting and viewing distance are still of the utmost importance. Arden suggests a 60 Watt globe 40 cm above the table on which the book is placed, in addition to normal room lighting. Viewing distance is 57 cm.[6]

In the book of Arden gratings (1st edition) each of the 5 pages has a single spatial frequency (except one which has 2 patterns) but the contrast varies from top to bottom of the page. The operator covers the test plate except for the lowest contrast area and gradually moves the cover to expose more and more of the higher contrast areas. (The cover should be a non contrasting neutral grey.)

The Arden grating plates are printed by a computer. If you could count the minute dots that make up the grey pattern on the page you would find exactly the same number of dots across the page on every horizontal line, from top to bottom of each page. In the zero contrast region (at the bottom of the page), the tiny black dots are all equally spaced across the page. In the higher contrast regions the dots are crowded and then spread out, repeatedly across the page, to form the darker and lighter parts of the spatial frequency pattern. Equal (or controlled) brightness and contrast levels are assured because the computer prints an equal (or controlled) number of dots for all patterns.

The operator has to decide, from the patient's response, at what level of contrast the spatial frequency is first detected. This level is read off an arbitrary scale (1-20), printed on the side of the plate, and is recorded for each plate (or frequency), thus forming a contrast sensitivity function for that patient. A total score of > 78 for all six plates is said to be abnormal, as is a difference > 5 between the right and left eye score.

CLINICAL FINDINGS

The fine close packed pattern of high spatial frequency is only detectable by the high acuity central foveal cells while the lower spatial frequencies are detected by much wider areas of the retina. Thus the Arden Gratings of low frequency give us a much better way of defining amblyopia – expressing its effect over a wide area. This technique has shown that there are two basic groups of amblyopes. Those with overall loss of sensitivity at all spatial frequencies and those with depression of sensitivity only at the high frequency region of the function. They may both have equal visual acuity, but obviously their visual abilities are quite different.[7]

In glaucoma Snellen acuity may remain unchanged in the presence of severe optic nerve damage and field loss. In contrast, Arden grating tests may show abnormal results very early in the disease before disc and field changes are demonstrable, and the scores become greater with increasing severity of the disease. The test can be scored so that a very sharp distinction may be made between normal and glaucomatous eyes.[8]

The *low* frequency gratings have another interesting and useful property – they are relatively unaffected by refractive errors, movement or changes in fixation (as in babies or people with nystagmus).

Contrast sensitivity tests can be used to test visual function when a cataract patient's vision is so low, due to opaque lenses, that he can hardly read any figures on a test chart. Spatial frequency gratings are generated on the retina itself as interference patterns, formed by the interaction of two laser beams projected into the eye by a special slit lamp. Thus the surgeon who cannot visualise the retina obtains a more accurate visual prognosis than is available by any other method.[5]

Contrast sensitivity tests give us a sensitive measure of visual loss in diffuse nerve diseases such as multiple sclerosis, where such loss is sometimes the only positive sign of early or dormant disease.[9]. A number of patients whose acuity is 6/6 in each eye describe a *qualitative* loss of visual acuity which we cannot measure at present except with contrast sensitivity tests. Legally they have normal vision. Functionally this is not true. (See Fig. 2). Such patients may be quite dangerous driving or flying in foggy conditions where low contrast, low spatial frequency sensitivity is very necessary.

Visual assessment of infants, animals and brain damaged patients requires objective rather than subjective methods. Where visual *acuity* measurements are impossible, contrast sensitivity tests are possible by behavioural reaction to spatial frequency stimuli (even in 5 week old babies[10]), or by interfacing the projected spatial contrast image with the patient's V.E.R. (Visually Evoked Response).

Thus contrast sensitivity tests provide a much more comprehensive and valuable assessment of a patient's visual function, than visual acuity tests.

The concept is applicable to all visual systems from single cells to the most complex imaginable and it is universally comparable. For example it is now easy to describe how a cat's vision differs from a human's[11]. It is also possible to accurately compare human visual ability with that of any other creature, even a fish or an insect.

CONCLUSION

In conclusion it is appropriate to quote from the British Journal of Ophthalmology; firstly, a 1978 review of a booklet[12] called "Spatial Contrast" (a report on a workshop held in Amsterdam in 1976):

"During the last 2 decades a number of visual scientists have used sinusoidal patterns of specific spatial frequency and contrast to investigate visual function. The approach is powerful, for it permits Fourier analysis to be used in interpretation and modelmaking and provides a common conceptual framework for neurophysiologists, psychologists and ophthalmologists. It has produced an impressive body of knowledge and has considerable further promise both for scientific and clinical investigation."

Secondly, from the Editorial of the British Journal of Ophthalmology (1978) Vol 62, p. 197:

"On present evidence it appears that spatial contrast sensitivity tests will be useful as a visual screening test, in the investigation of visual disturbance when other subjective tests are normal, and in the differential diagnosis in cases of visual loss ..... It will be evident that we now have a simple and potentially valuable investigative tool with wide application".

Lastly, from the summary of a paper[1] by Harold W. Skalka (1980): "Patients with various macular and optic nerve abnormalities underwent Snellen acuity, transient VER acuity, and Arden grating testing. Snellen acuity was the coarsest of the 3 evaluations, generally falling after Arden scores and VER acuity had already undergone significant degradation. The Arden gratings appeared to be the most sensitive of the 3 tests, equalling the VER performance in optic nerve diseases and surpassing it in macular diseases."

REFERENCES

1. SKALKA, H. W. (1980) Comparison of Snellen acuity, VER acuity, and Arden grating scores in macular and optic nerve diseases. Brit. J. Ophth 64: 24-29
2. DAVSON, H. (1972) Physiology of the Eye, Third Edition p. 244 Churchill Livingstone (Edin. and London)
3. MAFFEI, L., and FIORENTINI, A. (1977) Spatial Frequency Rows in the Striate Visual Cortex. Vis. Res. 17: 257-264
4. CAMPBELL, F. W., HESS, F. R., WATSON, P. G., BANKS, R. V. (1978) Preliminary results of physiologically based treatment of amblyopia. Brit. J. Ophth. 62: 748-755
5. CAMPBELL, F. W., and GREEN, D. G. (1965) Optical and retinal factors affecting visual acuity. J. Physiol. 181: 576-593
6. ARDEN, G. B. (1978) The importance of measuring contrast sensitivity in cases of visual disturbance. Brit. J. Ophth. 62: 198-209
7. HESS, R. F. and HOWELL, E. R. (1977) The threshold contrast sensitivity function in strabismic amblyopia; evidence for a two type classification, Vis. Res. 17: 1049-1056
8. ARDEN, G. B. and JACOBSON, J. J. (1978) A simple grating test for contrast sensitivity: preliminary results indicate value for screening in glaucoma. Invest. Ophth. 17: 23-32
9. REGAN, D., SILVER, R. and MURRAY, T. J. (1977) Visual acuity and contrast sensitivity in multiple sclerosis: hidden visual loss. Brain 100: 563-579
10. ATKINSON, J., BRADDICK, O. and MOAR, K. (1977) Development of contrast sensitivity in the first 3 months of life in the human infant. Vis. Res. 17: 1037-1044
11. CAMPBELL, F. W. and MAFFEI, L. (1974) Contrast and spatial frequency. Scient. Amer. 231, 5:106-114
12. HOLDEN, A. L. Reviews "Spatial Contrast" Brit. J. Ophth.

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A CLINICAL ASSESSMENT OF NEW METHODS OF TREATMENT FOR AMBLYOPIA

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Abstract
Following the psychophysical experiments which have established that the human visual system is highly tuned for spatial frequency and orientation, the Cam Vision-Stimulator was devised to rectify the reduced sensitivity found in amblyopia by stimulating the visual neurones in all orientations, during the period of occlusion. The results of this study are presented and discussed.

Key words
Amblyopia, contrast sensitivity, spatial frequency, spatial distorion, minimal occlusion.

For some patients total full-time conventional occlusion may cause little distress or upset, but for many patients this method of treatment can be disruptive – socially, domestically, educationally and emotionally.[1] In our experience, those patients who are upset by full-time occlusion fail to co-operate well, and thus the final visual outcome is lower than was originally expected. In order to reduce the distress, we have reduced the length of daily occlusion to twenty minutes, during which time the child is supervised by a parent, and encouraged to give maximum concentration to increasingly difficult visual tasks. Although it took slightly longer to achieve maximum visual acuity, the patients and the parents were happier and more co-operative and fewer failed to comply with their treatment.

TABLE 1

	STRABISMIC								AMBLYOPIA							
	MACULAR FIXATION				PARAMACULAR FIXATION				ECCENTRIC FIXATION				ANISOMETROPIC AMBLYOPIA			
METHOD OF TREATMENT and Visual acuities when treatment started.	No. of Patients	No. of weeks or treat-ments (aver-age)	No. → 6/12	No. → 6(9	No. of Patients	No. of weeks or treat-ments (aver-age)	No. → 6/12	No. → 6/9	No. of Patients	No. of weeks or treat-ments (aver-age)	No. → 6/12	No. → 6/9	No. of Patients	No. of weeks or treat-ments (aver-age)	No. → 6/12	No. → 6/9
MINIMAL OCCLUSION <6/60 – 6/24	3	23	1	–	2	34	1	1	11	20	3	5	1	16	–	–
6/18 – 6/9	4	13.5	–	4	3	16	–	3	1	40	1	–	5	16	–	5
CAM VISION-STIMULATOR <6/60 – 6/24	8	6.5	3	–	11	10	1	2	18	7.9	4	3	7	4.6	3	2
6/18 – 6/9	14	4.8	2	9	7	3.5	1	4	1	2	–	1	14	3	5	5

Table One
Comparison of results achieved with minimal occlusion, and with the Cam Vision-Stimulator.

We were therefore pleasantly surprised by the results achieved with this form of minimal occlusion, and were therefore encouraged to explore a fresh approach to the treatment of amblyopia.

The findings of recent psychophysical experiments have revealed that the human visual system, like the monkey's, is highly tuned and receptive to spatial frequency and orientation, and that cells in the visual areas of the brain respond selectively to gratings of a certain size and spatial orientation.[2/3] It has been shown that in amblyopia, this sensitivity is usually reduced, either in specific frequencies (low, medium or high) or in all.[4] In order to rectify this deficiency and to activate all the cortical visual neurones, the Cam Vision-Stimulator was devised on which a range of spatial frequency square-wave gratings could be slowly rotated at 1 rev/minute, covering all orientation.[5]

Pre-treatment Assessment

[6] Before treatment was commenced, all patients had a full ophthalmological investigation, cycloplegic refraction, and orthoptic investigation including visual acuities at near and far, using linear Snellen's test-types and single optotypes. The contrast sensitivity of either eye was assessed using a selection of round discs on which were printed low and medium sinusoidal gratings, of differing contrasts.[7]

Method of Treatment

To enhance the child's concentration and participation when possible two patients, matched for age, intelligence and level of visual acuity, were treated together.[8] The patients had their fixing-eye occluded during the treatment session, and each session lasted for approximately seven to ten minutes. Treatment commenced with the widest striped square-wave disc, which was rotated for approximately one minute. All the grating discs were rotated for one minute commencing with the widest striped square-wave disc (0.5 cycles/degree) and ending with the narrowest (32 cycles/degree). A perspex plate was placed over the rotating grating on which the children drew or played games such as O's and X's, dot-to-dot etc.

Most patients had no occlusion between treatment sessions, which were usually carried out at weekly intervals.[8] If this method of treatment is to be effective, some improvement in the visual acuity and/or contrast sensitivity should occur within the first three treatment sessions. For this reason, each patient was given three consecutive weekly treatments and if no improvement occurred, the situation was reviewed and an alterntive method considered.

Results

Eighty patients have completed treatment in this particular study and those who do less well are (i) eccentric fixators and (ii) those who have unsteady nystagmoid jerks in the amblyopic eye, possibly due to reduced effectivity of the 'W' cells. The follow-up period has been short, but three main points have emerged thus far:—

1. Most patients retain their maximum vision.
2. Some regression occurs in a few patients, most of whom have unsteady nystagmoid fixation jerks, with crowding or 'distortion' problems and better single-letter acuity than linear.
3. Some patients show spontaneous improvement after treatment has stopped.

The latter finding re-emphasises the need for extreme caution to be exercised if treatment is carried out in older strabismic amblyopes. The same criteria apply for this method of treatment as for conventional occlusion, and it is of utmost importance that, if the possibility of inducing intractible diplopia is to be avoided, this treatment should only be carried out with adequate medical and clinical supervision.

TABLE 2

IMPROVEMENT GAINED (Expressed by 6 metre Snellen acuity)	STRABISMIC Macular Fixation No. < 7 years old	> 7 years old	AMBLYOPIA DEGREE OF VISUAL Paramacular Fixation No. < 7 years old	> 7 years old	Eccentric Fixation No. < 7 years old	> 7 years old	ANISOMETROPIC Amblyopia No. < 7 years old	> 7 years old
< 1 line improved	2	6	–	6	1	6	2	4
1 line improved	5	4	–	3	1	3	2	3
2+ lines improved	2	3	4	5	4	4	3	7

Table Two
Results of patients treated with Cam Vision-Stimulator, showing the improvement expressed in lines on a Snellen's test-type at six metres.

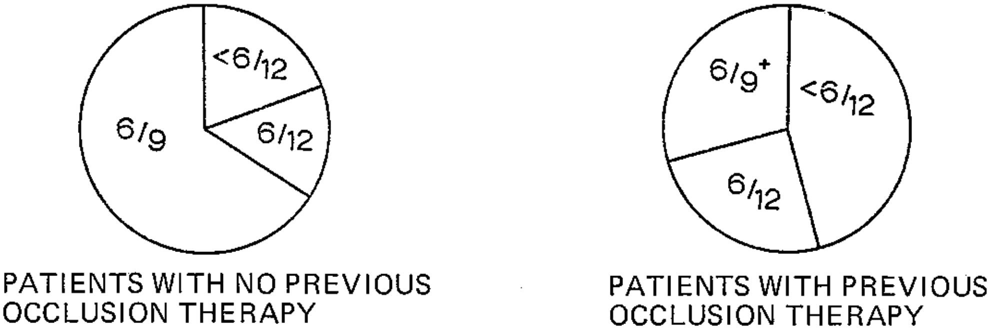

Figure 1
Comparison of the final six metre linear acuity achieved in the amblyopic eye of patients with macular fixation.

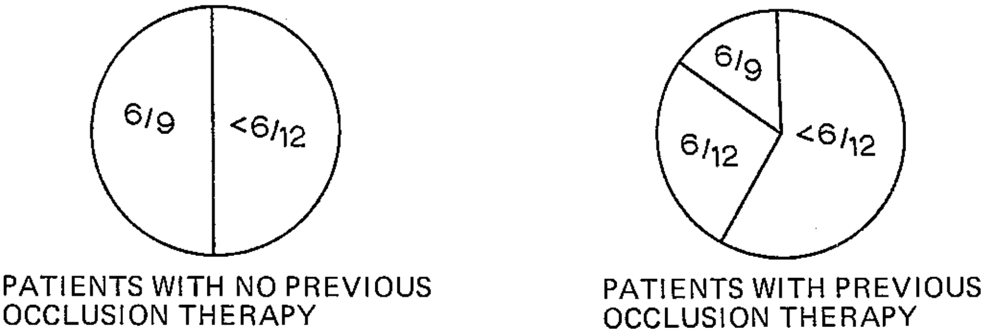

Figure 2
Comparison of the final six metre linear acuity achieved in the amblyopic eye of patients with eccentric fixation.

The following cases demonstrate spontaneous imrovement:
Case 1 – J.B. – seven years, early onset left esotropia, left eccentric fixation, unsteady nystagmoid jerks. Wearing $+4.50/+1.00_{90}$ R.E.; $+5.00/+1.50_{90}$ L.E. occluded unsuccessfully for four years. December 1977 – 6/6 R.E. 2/60 L.E. Seven treatments given with Cam Vision-Stimulator. May 1978 – 6/6 R.E.; 6/36 + 1 L.E. near and far. Treatment stopped. July 1978 – 6/5 R.E.; 6/36 linear, 6/24 singles 6 metres; 6/24 near L.E. March 1979 – 6/5 R.E.; 6/18 linear, 6/12 singles 6 metres; 6/18 near L.E. Left fixation paramacular and unsteady.

Case 2 – J.H. – seven years; small exophoria, good binocular functions, normal contrast sensitivities. Refraction revealed: + 1.00 D.S. R.E.; $+2.00/-5.50_{175°}$ L.E. Vision – 6/6 R.E.; 6/12+ linear, 6/9 singles 6m; 6/9 near L.E. Three treatments given – 6/5 R.E.; 6/9+ linear 6m; 6/9 near L.E. Three treatments given – 6/5 R.E.; 6/9+ linear 6m; 6/6 near L.E. Seven months later – 6/5 R.E.; 6/5 partly L.E. 6m.

A few adult amblyopes who have lost the vision in their originally sound eye have been treated with some success. Their motivation is obviously great, and most show some spontaneous improvement without treatment – other than the constant occlusion that they are effectively having. If no improvement occurs, there may be a pathological element present, hindering progress.

Case 3 – A.M. – 23 years; congenital right esotropia, amblyopia, eccentric fixation. Occluded unsuccessfully in childhood. Motor accident at twenty two – left vision lost, 6/36 R.E. Six weeks later – 6/12 R.E. No further improvement; five daily treatments given – 6/9+ 6 m, N.5 R.E., unsteady macular fixation R.E. with mal-projection. Further five daily treatments given three months later – 6/6 6m, N4.5 easily R.E., correct projection.

Discussion

This method is a significant advance in the treatment of amblyopia – both physiologically and ophthalmologically. At present, it seems to be impossible to forecast the effect of treatment on each individual patient as they all seem to react differently. Although not all patients respond well, some do show large improvements in vision and contrast sensitivity after a very short exposure to the rotating gratings, and frequently it is those who would not be expected to improve much, due to well-established criteria for regaining vision in an amblyopic eye, who respond dramatically!

Disadvantages of this method of treatment can be cited – e.g. travelling difficulties and expense for parents to bring children to be treated on a weekly basis, weekly disruption to child's education, and use of orthoptist's time. However, these disadvantages should be weighed against the advantages e.g. fast rate of improvement of vision, no supplementary occlusion is usually required between treatment sessions, the children enjoy the treatment and will therefore co-operate well, resulting in a good record of attendance and co-operation. This latter factor may well be the most important aspect as the prognosis for achieving satisfactory visual results can usually be measured by the co-operation and enthusiasm of both the patient and the parent.

Many reasons have been put forward for the effectiveness of this treatment, but have yet to be proved. Much research has still to be done, but the fact that we do not know exactly what effect this treatment has, does not detract from the observation that visual acuity and contrast thresholds can be rapidly improved without distress or anxiety to the patient. We hope at the very least that this method of treatment will provide an effective alternative to conventional occlusion.

Acknowledgements

I should like to thank Dr. Fergus Campbell, Physiologist of Cambridge University, who devised this treatment, and Mr. Peter Watson F.R.C.S. for his help and encouragement. I should also like to thank all members of the Orthoptic Department at Addenbrooke's Hospital for all their help and discussion with this project, and Mr. J.E. Cairns F.R.C.S. and Mr. J. Keast-Butler, F.R.C.S. for providing suitable patients.

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REFERENCES

1. DUKE-ELDER, S. System of Ophthalmology Vol. VI. H. Kimpton. London 1973. p. 427.
2. CAMPBELL, F. W., CLELAND, B., COOPER, G. F., and ENROTH-CUGELL, C. The angular selectivity of visual cortical cells to moving gratings. Journal of Physiology (1968) 198, 237-250.
3. MAFFEI, L. and FIORENTINI, A. The visual cortex as a spatial frequency analyser. Vision Research (1973) 13, 1255-1267.
4. HESS, R.F., and HOWELL, E.R. The threshold contrast sensitivity function in strabismic amblyopia: evidence for a two-type classification. Vision Research (1977) 17, 1049-1057.
5. BANKS, R. V., CAMPBELL, F. W., and HOOD, C. A neurophysiological approach to the treatment of amblyopia. Journal of Physiology (1978), 275, 16-17.
6. WATSON, P. G., BANKS, R. V., CAMPBELL, F. W., and HESS, R. F. (1978). A clinical assessment of a new treatment of amblyopia. Strabismus. Reinecke, R. D., (Editor) New York: Grune and Stratton, Inc.
7. CAMPBELL, F. W., HESS, R. F., WATSON, P. G. and BANKS, R. V. Preliminary results of a physiologically based treatment of amblyopia. British Journal of Ophthalmology (1978) 62, 748-755.
8. BANKS, R. V., CAMPBELL, F. W., HESS, R. F. and WATSON, P. G. A new treatment of amblyopia. British Orthoptic Journal (1978) 35, 1-12.
9. BANKS, R. V., and BARNETT, M. F. A clinical assessment of new alternative methods of treatment of amblyopia. Proceedings of IVth International Orthoptic Congress (Berne). In press (1979).
10. HESS, R. F., CAMPBELL, F. W., and GREENHALGH, T. On the nature of the neural abnormality in human amblyopia; neural aberrations and neural sensitivity loss. Pflügers Arch. (1978) 377, 201-207.

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SUMMARY OF R.C.H. and N.V.R.I. Control Trial of Cam Stimulator

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This summarises a paper to be published in the British Journal of Ophthalmology.

In 1978 Banks *et al.* reported that the vision in amblyopia can be significantly improved by brief weekly periods of occlusion of the good eye while the child performs concentrated visuomotor tasks against a background of rotating gratings. At the Royal Children's Hospital, Flemington Rd., Parkville, Melbourne and the National Vision Research Institute of Australia in Melbourne a controlled trial was conducted to investigate the role played by the gratings in this procedure; one group (n = 33) of amblyopic children viewed a series of rotating gratings during treatment while the other group (n = 27) performed exactly the same visuomotor tasks against a homogeneous grey background.

Particular attention was placed on the choice of tests of visual acuity in order to highlight the crowding phenomenon that is a characteristic feature of the visual loss in amblyopia. The chart selected for this purpose was the Bailey-Lovie chart in which the number of letters on each line was held constant and the letter sizes and spacing were graded in equal logarithmic steps. While some improvement in vision occurred in almost all cases, no significant difference was found between the group that viewed the rotating gratings and the control group that viewed the homogeneous grey disc. Furthermore, there was no detectable difference between the two groups in either the rate of improvement of vision or in the tendency of the vision to be maintained or even improved following cessation of treatment. Since there was no indication that the patients treated with gratings improved more than those in the control group, we conclude that the visual recovery was promoted by some other aspect(s) of the procedure.

COMMENTS ON THE CAM STIMULATOR FROM NEWCASTLE, N.S.W.

Patricia Dunlop, D.B.O.(D.) (Lond.)

The Cam Stimulator has been used in Newcastle since September 1978 on patients with various types of amblyopia and certain cases of learning disability. Patients included in this survey came from the normal case load during the period stated and were in no way selected to represent a particular research programme. Consequently most patients included already had conventional treatment for their amblyopia and learning disability and had failed to achieve a satisfactory result when the Cam Stimulator became available. Cam Stimulator treatment is generally employed in an effort to improve visual function over the spatial frequencies of the square wave gratings issued with the machine. Therefore visual acuity testing on the Snellen test type for distance and/or for near may not fully indicate any change in acuity due to Cam treatment because Snellen acuity is mainly concerned with high frequency discrimination.

Because the Snellen acuity seems an unsatisfactory way of monitoring the change in acuity after Cam stimulation a score for each eye on the Arden gratings prior to and following treatment sessions was carried out in all the cases.

Table 1 shows the number and type of 47 amblyopic patients treated with the Cam Stimulator between October 1978 and July 1979.

TABLE 1
Cam Stimulator Treatment Survey
October 1978 – July 1979

	No.	%
1. Strabismic Amblyopia	23	49
2. Anisometropic Amblyopia	16	34
3. Combined Strabismic/Anisometropic Amblyopia	6	13
4. Deprivation Amblyopia	2	4
Total	47	100

In Newcastle many patients are examined and treated because of a learning disability. These children generally have good visual acuity (on Snellen testing) about 6/6–6/5 level and it is usually equal. At present occlusion and convergence exercises are the routine treatment. The purpose of this is to try to change the reference eye to the eye corresponding with the preferred hand.

61 patients with learning disability (suppression of the reference eye and crossed correspondence types) were also included in the Cam Stimulator treatment programme.

Table II shows the number of patients whose vision improved on the Snellen chart and/or on the Arden gratings as a result of Cam Stimulator treatment. The number of patients who had previously worn conventional occlusion is also shown. All

TABLE II
Results of Treatment

Type	Previous Occlusion	Improved V.A. (Snellen)	Improved Gratings (Arden)
1. Strabismic Amblyopia 23	23	13 (60%)	17 (74%)
2. Anisometropic Amblyopia 16	13	10 (63%)	12 (75%)
3. Combined Strabismic/Anisometropic Amblyopia 6	4	2(33%)	3 (50%)
4. Deprivation Amblyopia 2	2	2 (100%)	2 (100%)
Total 47	42	27 (57.5%)	33 (70%)

cases were under the age of twelve years at the time of treatment and all had central fixation in both eyes. The two cases of deprivation amblyopia were due to eye injury at about four years of age. These were both successfully treated with initial conventional occlusion followed by Cam stimulation, each obtained equal visual acuity on Snellen testing for near and distance and on Arden Gratings.

It can be seen that most of the patients already had previous occlusion prior to Cam treatment, however 27 patients (57%) showed improved visual acuity (Snellen) and 33 (70%) gained improved score on Arden gratings.

Conventional occlusion, in certain cases of amblyopia whether total, part-time or minimal, appears to leave certain aspects of vision still defective, even when this is undertaken with good co-operation from patient and parents. The above results suggest that the Cam Stimulator may be still effective in improving visual acuity even when conventional methods have been only partially successful.

Of the 61 learning-disability children treated, 44 had previous occlusion, 7 (11%) showed improved visual acuity, and 46 (75%) showed improved score on Arden gratings. One would not expect much change in Snellen acuity, as good visual acuity in both eyes is characteristic in specific dyslexia and in many learning disability cases. However it was pleasing to note the improved gratings score. Many patients reported definitely improved scholastic performance after the treatment.

In the entire group the number of treatments per patient varied between two and five with a mean of three. Weekly treatment was impossible for geographical and economic reasons. Sessions were once in four to six weeks, and in some cases spontaneous improvement occurred after a period of several months, even up to six months.

One patient with amblyopia and no binocular vision complained of diplopia intermittently when debilitated with 'flu, after two Cam sessions. Cam treatment was immediatly discontinued and no further symptoms occurred – amblyopia is still present.

In the present series, encouraging results have been obtained, in cases of both amblyopia and learning disability.

It should be realised that Cam Stimulator treatment is a powerful stimulus and that it should be undertaken with due care and well defined purpose. As well as a treatment for amblyopia, it appears to be a useful adjunct to the present regime in cases of learning disability where it may be especially valuable for the teenagers who resent occlusion and are unwilling partners in any presently used treatment schedule.

RESULTS OF TREATMENT WITH THE CAM VISION STIMULATOR FROM SYDNEY EYE HOSPITAL

Shayne Brown. D.O.B.A.
(Orthoptist-in-charge)

The results are recorded of 36 patients who had completed treatment on the Cam Vision Stimulator in a 16 month period from May 1978 to August 1979. Table 1 shows the type and number of patients treated with the Cam Vision Stimulator.

TABLE 1
Type and number of patients treated with the Cam Vision Stimulator

1. Strabismic Amblyopia	= 13
2. Anisometropic Amblyopia	= 7
3. Combined Strabismic/Anisometropic Amblyopia	= 13
4. Depriviation Amblyopia	= 3
TOTAL	= 36

All the patients who attended for treatment had:

1. Full ophthalmological examination, including a cycloplegic refraction.
2. Visual acuity with a linear chart and a near vision test.
3. Assessment of the fixation pattern.
4. Assessment of the binocular state.

Choice of treatment discs was determined by assessing the contrast threshold with the square wave gratings. One disc above, and all discs below the threshold were used in the treatment sessions. We have since noted that use of all discs is advised. It is possible that the results may have been different if all gratings had been used. Treatment time varied according to the concentration of the patient. No patient had treatment of under one minute per disc.

No occlusion was worn in between treatment sessions. Treatments were given weekly in most cases, and the visual acuity assessed at the end of each session. Treatment was discontinued when no further improvement was gained. The patients were reassessed after an interval of one month without treatment.

In assessing the results, "improvement" is defined as improvement in the distance visual acuity of ONE LINE or more as assessed on a linear vision chart, or one grade of near vision. 27 patients had had previous treatment but precise details of the response to conventional occlusion is not now available. Table 2 shows the results.

It can be seen that 17 patients **did not** improve at all. 19 patients showed some improvement. The greatest amount of improvement was in the patients' near vision, where there was an average of 2.3 near grades, as compared with the distance vision where there was an average of 1.6 lines of improvement recorded. 64% of the patients were between 6-9 years of age. Normally the prognosis in such a group would be poor for 100% improvement, so it is felt that these results are encouraging.

In conclusion, the orthoptists using the Cam Vision Stimulator found it simple to administer, and the treatment sessions were enjoyed by the patients. Many parents found attending for treatment sessions less traumatic than battling with a patch at home. This is perhaps significant when dealing with older children.

TABLE 2
Results of treatment

TYPES	No. Previously Occluded	No. with Improved V.A. Distance / Near	No. Showing Improvement
1. Strabismic Amblyopia 13	10	5 / 4	6
2. Anisometropic Amblyopia 7	5	6 / 6	6
3. Combined Strabismic/Anisometropic Amblyopia 13	9	6 / 6	6
4. Deprivation Amblyopia 3	3	1 / 1	1
Total 36		TOTAL =	19 (52%)

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ORTHOPTIC TREATMENT IN TWELVE CASES OF ECCENTRIC FIXATION

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This paper was written while the author was a third year student in Orthoptics at The Cumberland College of Health Sciences, Lidcombe, NSW.

Abstract
The results of treatment by occlusion and the Cam Stimulator in 12 cases of eccentric fixation were studied. Inverse occlusion disrupted fixation in all convergent deviations within 3 months and its effect on visual acuity was varied. Mixed and direct occlusion improved both visual acuity and fixation pattern in most patients.

Key words
Eccentric fixation, occlusion, Cam Stimulator.

Aim

The aim of this paper is to:

1) study the methods and the results of orthoptic treatment in twelve cases of eccentric fixation.
2) examine the individual forms of treatment, especially inverse occlusion and direct occlusion. Also to briefly examine mixed occlusion, including red filter treatment, gradual fixing eye occlusion and the Cam stimulator.
3) see the effects of each major form of treatment on visual acuity and the fixation pattern
4) observe the effects of age and co-operation on treatment
5) evaluate the degree of improvement in visual acuity and fixation in each patient.

Eccentric fixation: a uniocular condition in which there is fixation of an object by an area other than the fovea. The area adopts principal visual direction, except in eccentric viewing, where the fovea maintains straight ahead projection.

Selection of patients

1) Patients treated by both inverse and direct occlusion were chosen
2) Patients of varying ages were selected
3) Completed cases were preferred, but this was not always possible and several patients used here are still continuing treatment
4) Personal participation was limited since most treatment was extended over months and sometimes years. Information gained was therefore predominantly from orthoptic records.

Methods

Each orthoptic record was examined for:

1. Age at first visit
2. Sex
3. Type of deviation and size
4. Initial and final fixation
5. Initial and final V.A.

The full treatment was recorded, including the type of occlusion and the duration of treatment.

The results of treatment were recorded in terms of fixation and visual acuity. The onset of the condition could not be recorded due to inadequate information. The area of fixation was recorded in the usual terms of central, parafoveal, paramacular and peripheral fixation. Fixation was recorded as steady, unsteady, or wavering.

The area of fixation could be:

1) congruous and correspond to the direction of the deviation, i.e. nasal in a convergent deviation and temporal in a divergent deviation
2) paradoxical, i.e. nasal point used in a divergent deviation.

In Figure 1 the twelve responses to inverse occlusion are plotted in relation to time.

FIGURE 1

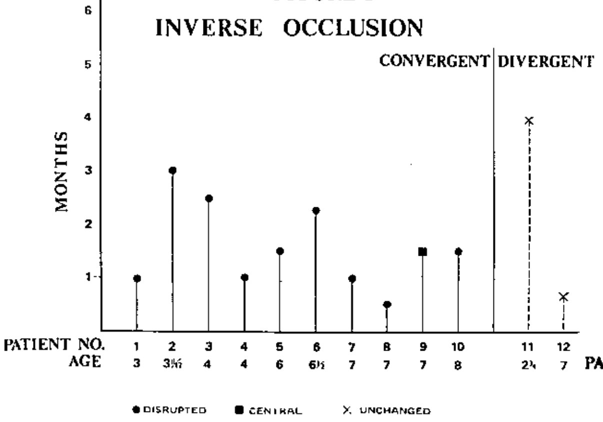
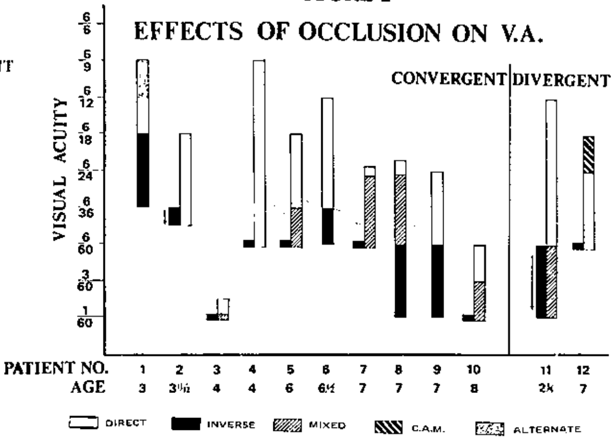


FIGURE 2



This fig. shows that:

1. One patient assumed central fixation, nine patients showed disrupted fixation patterns, and in two the area used for fixation remained unchanged.

   Inverse occlusion was effective in breaking down the fixation pattern in 10 out of 12 cases. All convergent deviations responded well to inverse occlusion, whereas the two divergent deviations failed to respond.
2. The results were evident in 3 months or less, supporting the views of Duke Elder[1] and Lyle and Wybar[2] that three months is long enough to ascertain the effects of inverse occlusion.
3. Age did not seem to influence the response to inverse occlusion. The only patient to achieve central fixation being 7 years old. However it is difficult to draw conclusions without additional data concerning onset of the condition.

Mixed Occlusion

Mixed or gradual fixing eye occlusion was used in this study in several instances. It is an intermediate step between inverse and direct occlusion.

The functions of mixed occlusion are:

1. To allow fixation to become central and steady
2. To gradually prepare the patient for direct occlusion
3. To avoid the danger and inconvenience of direct occlusion where V.A. is too poor.
4. To improve V.A.

Figure 2 shows the cumulative effect of each type of occlusion, i.e. INVERSE, MIXED and DIRECT on the visual acuity of each patient.

This fig. shows that:

1. The V.A. improved with inverse occlusion in four cases, remained unchanged in six cases and worsened in two cases. The effects of inverse occlusion on V.A. are therefore varied.
2. Mixed occlusion was successful in improving V.A. where the patient was cooperative. Patient 3 was not cooperative and showed no improvement with mixed occlusion.
3. Direct occlusion improved V.A. in all cases.
4. Alternate occlusion – used in Case 1 following direct occlusion improved V.A.
5. In Case 12 the Cam stimulator improved V.A. following direct occlusion.

The effects of mixed and direct occlusion on fixation followed a pattern similar to that found in V.A. improvement.

Mixed occlusion improved fixation slightly in all cases where the patient was co-operative.

Direct occlusion improved fixation in 10 patients, four of these assuming central fixation. In one patient the fixation pattern remained unchanged and fixation in one patient became further eccentric.

Alternating occlusion achieved central fixation in Case 1.

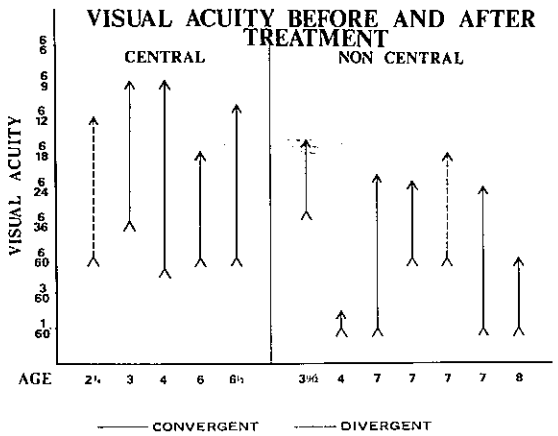
Case 11, a divergent deviation, assumed central fixation with direct occlusion, whereas inverse occlusion had been unsuccessful. Patient 12, divergent also, showed a very slight improvement in fixation after two sessions on the Cam Stimulator.

Figure 3 represents the improvement in V.A. in cases of central and non central fixation. The lower point represents initial VA and the higher one final VA.

The fig. shows that:

1. V.A. improved in all cases. All patients commenced with 6/36 or worse vision and improved to 6/24 or better, except two.

FIGURE 3



2. V.A. achieved by central fixation was generally better than that of non central fixation.
3. Age showed little effect on results obtained in central fixation. Age did seem to reduce the efficacy of treatment in non central fixation.
4. The two cases with divergent deviation showed differing results. Case 11 assumed central fixation and improved in V.A. by 4 lines from 6/60 to 6/12. Cases 12 did not take up central fixation, but showed an improvement in V.A. of 3 lines from 6/60 to 6/18.

CONCLUSION

1. Inverse Occlusion
   1) In this study, inverse occlusion has been shown to be useful in disrupting the eccentric fixation pattern in convergent squint only – these numbering 10 out of 12 cases studied.
   2) The results of inverse occlusion were evident in 3 months or less and therefore longer periods of occlusion may not be necessary.
   3) Age did not seem to affect the results of treatment by inverse occlusion. Ages ranged from 2¾ to 8 years of age, with a seven year old achieving central fixation. This form of treatment should therefore, according to this study, not be withheld on the grounds of age alone.
   4) The effect of inverse occlusion on V.A. was variable with 4 cases showing an improvement. However, the main function of inverse occlusion is not to improve V.A., but to disrupt the pattern of eccentric fixation.
2. Mixed occlusion, although not used in all cases, showed improvement in both fixation pattern, and in V.A., in co-operative patients.
3. Direct occlusion was most effective in improving VA. in every case. Fixation also improved in 10 out of 12 patients and 4 of these assumed central fixation.
4. General
   1) An overall improvement was evident in all patients except one. Visual acuity initially was 6/36 or worse and improved to at least 6/24 or better in all except two patients.
   2) Age seemed to decrease improvement in V.A. in cases of non-disruptable eccentric fixation.

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REFERENCES

1. DUKE-ELDER, SIR STEWART. "Systems of Ophthalmology" Vol. 4 Ocular Motility and Strabismus. Henry Kimpton, London, 1973. p. 208, p. 429.
2. LYLE, T. KEITH and WYBAR, KENNETH C. "Lyle and Jackson's Practical Orthoptics in the Treatment of Squint" 5th Ed. H.K. Lewis and Co Ltd London, 1970 p. 271.

BILATERAL ECCENTRIC FIXATION – FACT OR FIXATION?

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Abstract
It has been found that bilateral eccentric fixation occurs in a significant number of amblyopes. The literature concerned with this condition and possible aetiological factors is reviewed. A retrospective study of 347 amblyopes was carried out and those patients with bilateral eccentric fixation are discussed and the possible reasons for this conditions are examined.

Key words
Bilateral eccentric fixation, eccentric fixation, amblyopia, visuscopy, normal visual acuity, simultaneous (bilateral) microstrabismus.

INTRODUCTION

Eccentric fixation is a well recognised monocular condition in the amblyopic eye in unilateral squint. Recently however eccentric fixation as a purely monocular phenomenon has been challenged, as case reports of bilateral eccentric fixation have occurred in the literature. These cases present a similar clinical picture to unilateral eccentric fixation, but with persistent sub-normal vision and eccentric fixation also being found in the so-called "sound" eye.

AIM

To discuss the relevant literature associated with bilateral eccentric fixation and review the results of clinical research of patients with this condition.

REVIEW OF LITERATURE

von Noorden and Mackenson (62)[1] first reported the phenomenon of bilateral eccentric fixation without strabismus, in cases of long-standing bimacular disease. The loss of macular function creates the need to fix with an area outside the central scotoma so that, with time, the principal visual direction and motor behaviour may become associated with the extrafoveal area.

von Noorden (63)[2] was the first to describe two cases of bilateral eccentric fixation with strabismus, in the absence of organic macular disease.

The phenomenon was further described by Hermann and Priestley (65)[3] who speculated that in certain cases, amblyopia and eccentric fixation is a bilateral disease in which bifoveal instability is present in both eyes, but with only one eye becoming significantly amblyopic.

Malik *et al* (68 & 72)[4,5] postulated that neonatal macular haemorrhage could lead to bilateral eccentric fixation and felt that the original lesion recovers structurally but leaves a functional defect which is then amenable to treatment.

Bilateral eccentric fixation has also been reported by Gupta and Sood (73)[6], in the presence of microstrabismus with identity – where there is no demonstrable squint on cover test, but eccentric fixation is present.

Mein (75)[7] commented that if "bilateral eccentric fixation does occur in cases of bilateral amblyopia without a manifest strabismus on cover test, and with demonstrable binocular single vision, then it would appear that microtropia with identity can occur bilaterally and is not confined to one eye."

METHOD

A retrospective study of patients attending the Orthoptic Clinic at the Sydney Eye Hospital over an 8 month period was carried out. During this period, a total of 347 amblyopes were seen, of which 45 had bilateral eccentric fixation.

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These patients were given a routine ophthalmological examination including atropine or cycloplegic refraction and fundus check. A routine orthoptic examination was also given, including visuscopy which was performed on all patients by at least two orthoptists and was repeated on successive visits. BOTH eyes were subjected to very careful scrutiny.

Special tests were performed on some of these patients, including dark adapted visual acuity with the neutral density filter, colour vision with either the Ishihara or Matshubara Colour Vision Tests, Haidinger's Brushes and Visual Evoked Response.

Treatment, including glasses, occlusion, surgery, was given where indicated. No pleoptic treatment was given.

RESULTS.

Of the 347 amblyopes (i.e. those patients with 6/9 or less vision) 149 (42.9%) had bilateral amblyopia and 45 had bilateral eccentric fixation. 4 cases were excluded as the vision in one eye was 6/5 and another 2 cases were excluded because of the presence of pathology, leaving a total of 39 cases (11.2%). Since this survey was completed a further 8 cases have been seen, giving a total of 47 cases with bilateral eccentric fixation.

Sex Distribution.

Of the 47 cases, 30 (64%) were female and 17 (36%) were male.

Age Distribution.

The age range of patients at their first visit was from 5 months to 27 years. The average age at first attendance was 6 years.

Refractive Error.

This has been taken in terms of *retinoscopy* for use in this paper because it has been found that the glasses ordered do not necessarily reflect the amount of error present. Refractive errors have been taken as the *spherical equivalent* (the sum of the power of the spherical lens plus half of the power of the cylinder) for use in the tables and figures below.

TABLE 1

REFRACTIVE ERROR

(by retinoscopy – unknown in 12 eyes)

amount of error	no. of eyes	%age
+6.25 and over	36	43.9
+2.25 to +6.00	30	36.6
–2.00 to +2.00	9	11.0
–2.25 to –6.00	4	4.9
–6.25 and over	3	3.6

It can be seen in Table 1 that the majority of eyes have a refractive error in the higher plus range.

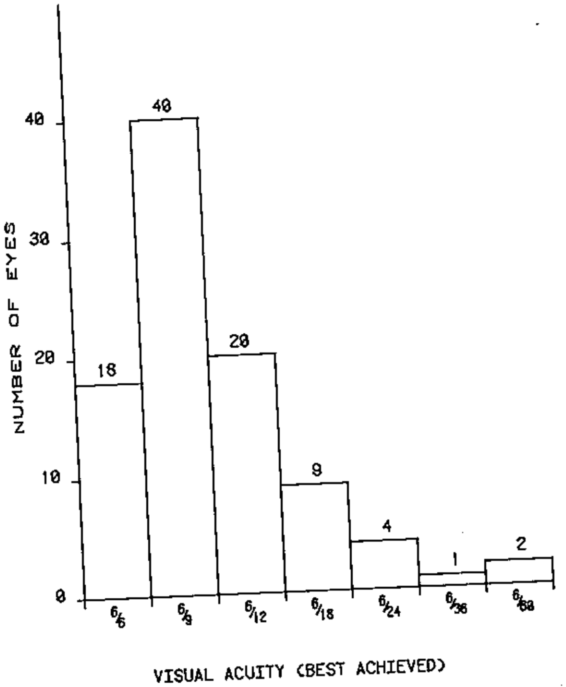
Astigmatism of 1.25 dioptres or more was present in 32 eyes.

Anisometropia of 2 dioptres or more was present in 8 patients.

Type of Strabismus.

32 cases (68%) had convergent squint – 18 of which were microsquint
8 cases (17%) had divergent squint – 5 of which were microsquint
2 cases (4%) had no demonstrable squint
5 cases (11%) had simultaneous squint (see comment below)

FIG. 1



Visual Acuity.

Figure 1 shows the distribution of the final (best achieved) visual acuity. It can be seen that 83% of eyes had an acuity of 6/12 or better, in fact 62% had 6/9 or better, showing that there can be a significant incidence of eccentric fixation even with higher levels of vision.

Figures 2 and 3 show the correspondence between:

i) the final visual acuity and the age at first correction
ii) the final visual acuity and the degree of error.

FIG. 2

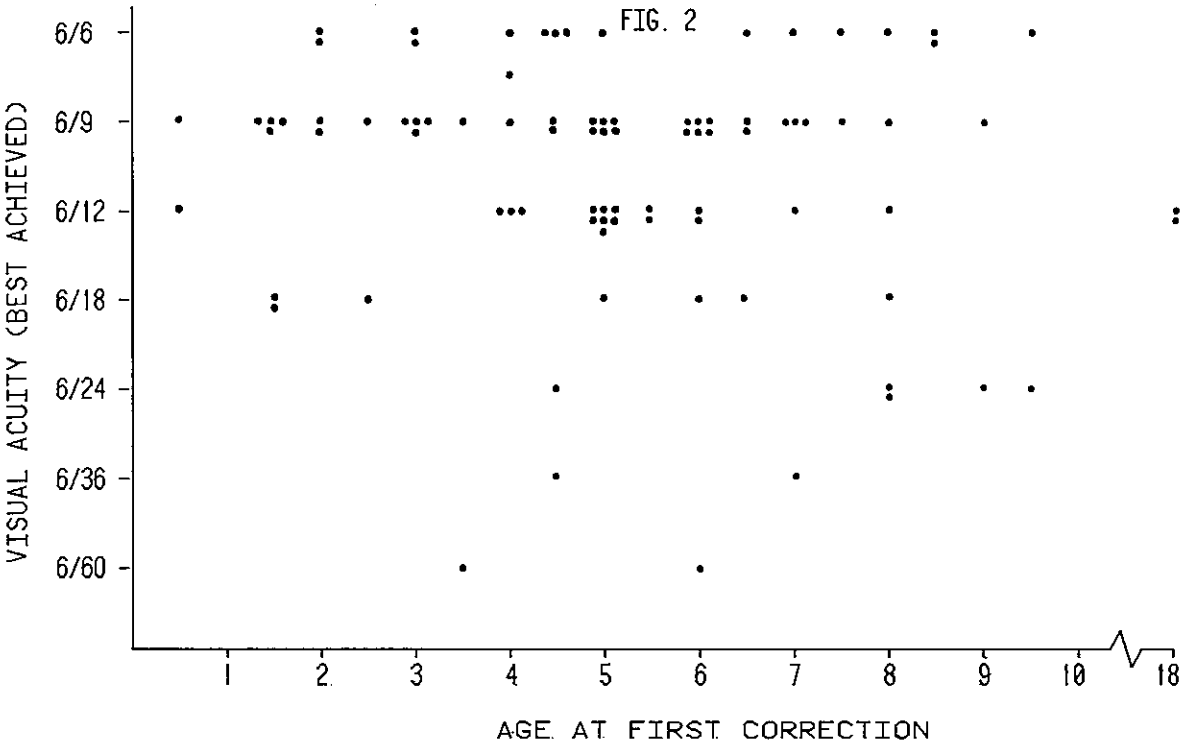
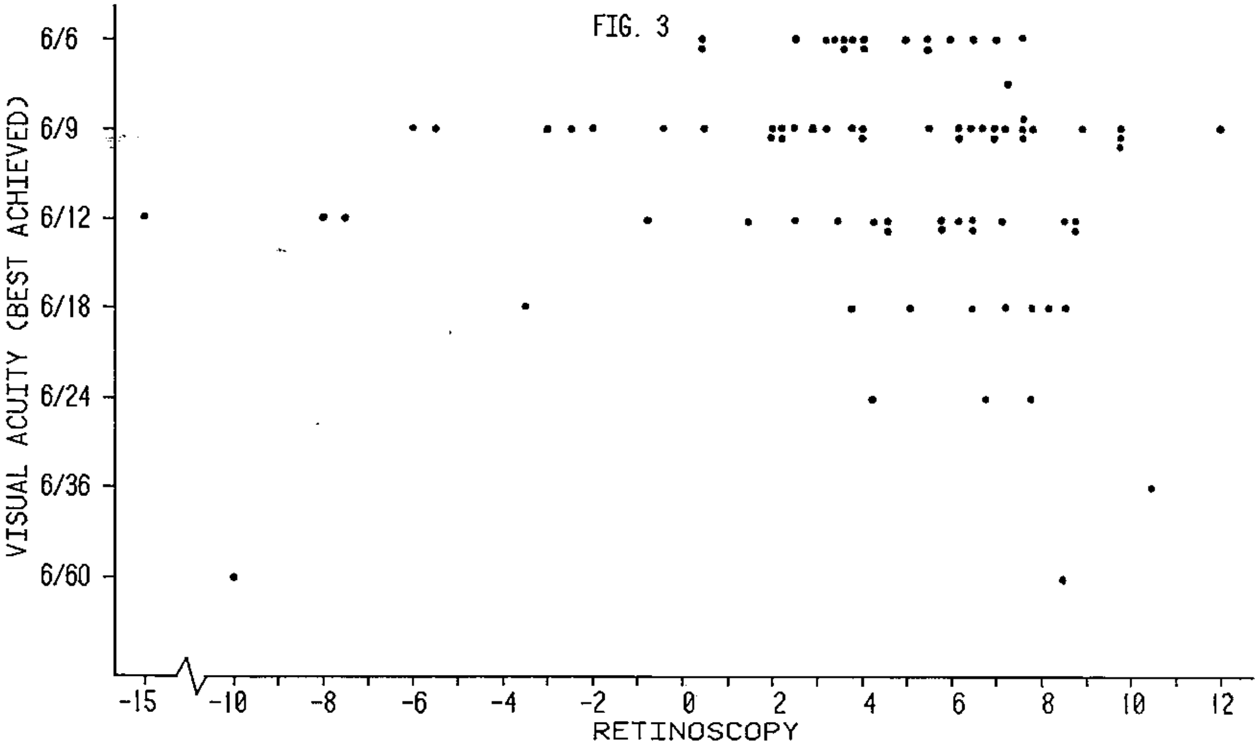

VISUAL ACUITY (BEST ACHIEVED)
6/6
6/9
6/12
6/18
6/24
6/36
6/60
1
2
3
4
5
6
7
8
9
10
18
AGE AT FIRST CORRECTION

FIG. 3


VISUAL ACUITY (BEST ACHIEVED)
6/6
6/9
6/12
6/18
6/24
6/36
6/60
-15
-10
-8
-6
-4
-2
0
2
4
6
8
10
12
RETINOSCOPY

It can be seen from both the above that there is no direct relationship between the best achieved acuity and either of the other two variables.

Fixation.
Parafoveal – 62 eyes (66%) – 5 with nystagmus
Macular – 27 eyes (29%) – 10 with nystagmus
Paramacular – 2 eyes (2%)
greater than paramacular – 3 eyes (3%) – 2 with nystagmus

Special Tests.
The special tests as mentioned before were performed on some of these patients, none of whom gave conclusively abnormal results.

Comment.
Several patients have initially presented with a unilateral microstrabismus with bilateral amblyopia and eccentric fixation. These patients have shown a most unusual response when following occlusion they demonstrated a *bilateral* or *simultaneous microstrabismus,* usually greater in the more amblyopic eye. In accordance with Mein (75)[7] a microtropia with identity could also exist in the better eye, as there is eccentric fixation in the absence of any demonstrable squint. Hermann and Priestley's concept of bifoveal instability could explain the phenomenon of bilateral squint where following occlusion of the better eye the latent instability and any underlying deviation could become manifest resulting in a bilateral squint. After cessation of occlusion, most patients reverted to their original squinting pattern.

DISCUSSION.
Hermann and Priestley (65)[3] stated that in a large series of amblyopes, about 10% will show bilateral eccentric fixation and amblyopia. Malik *et al* (68 & 72)[4,5] found similar figures of 8.5% and 9.8% respectively. The figure found in this survey – 11.2% – corresponds closely with these.

There have been several possible theories as to the aetiology of bilateral eccentric fixation.

Pathology.
1. *Neonatal Macular Haemorrhage* – Malik *et al.* (68 & 72)[4,5] suggested that macular haemorrhage at birth, which later resolved structurally, could leave a functional defect and therefore decreased foveal sensitivity. Enoch (59)[8] put forward the theory of receptor amblyopia caused by malorientation of the foveal receptors. Burian (59)[9] in his discussion of that paper, suggested that this malorientation could be as a result of neonatal macular haemorrhage. Surveys have been carried out since then by von Noorden *et al.* (73)[10] and Lowes *et al.* (76)[11] with 4-5 year follow-ups of children with this condition. The findings in both reports gave no support to the existence of organic amblyopia or strabismus following neonatal macular haemorrhage.

2. *Foveal Hypoplasia* – Duke Elder[12] states that decreased visual acuity may be partly due to a lack of retinal development, e.g. foveal hypoplasia. This condition is usually associated with other eye disorders (albinism, aniridia) however, there have been rare reports of isolated foveal hypoplasia, unassociated with these conditions. Curren and Robb (76)[14] and Yoshizumi *et al.* (79)[15] found that in these cases the following characteristics were seen:

i) decreased or absent foveal reflex
ii) poorly defined pigmentation in the macular area
iii) abnormally small vessel-free area
iv) bilaterally reduced vision
v) noticeable nystagmus.

In this present series of bilateral eccentric fixators the above characteristics were found in 14 cases (29.8%) as follows:

i) decreased or absent foveal reflex – 10 eyes – 10.6%
ii) poorly defined macular – 5 eyes – 5.3%
iii) small vessel-free area – 4 eyes – 4.3%
iv) bilaterally reduced vision – all cases
v) nystagmus – 14 eyes – 14.9% – present on visuscopy.

Thus in some cases of amblyopia, this condition may exist in lesser degrees, with reduced vision being the most obvious manifestation. Duke Elder[13] states that this condition may occur in cases of high hypermetropia.

Refractive Error. (Ametropic Amblyopia)

1. Duke Elder[12] states that vision may remain at a sub-normal level when refractive errors are not corrected until late in childhood. However, in reference to Figures 2 and 3 it can be seen that there appears to be no direct relationship between the best vision achieved and either the degree of error or the age at first correction. Abraham (64)[16] found that most patients in his survey achieved a visual level of 6/9, when a significant refractive error was present. However, this level of acuity can

still be classified as amblyopia and there is still a high possibility of eccentric fixation being present. In this survey, 40 (85%) of patients had 6/9 or better vision in one or both eyes, in the presence of bilateral eccentric fixation.

2. Hill and Ikeda (71)[17] reported on experiments performed on cats to test the response characteristics of retinal ganglion cells to focussed and blurred imagery. On testing the receptive field of an individual ganglion cell under focussed circumstances, they found that sensitivity was greatest at the field centre and declined markedly with increasing eccentricity. The cats were then tested with increasing powers of plus and minus lenses in front of the eye. As the power (refractive error) increased, the central responsiveness of the receptive field declined and the field periphery became relatively more active. In further experiments, Ikeda and Wright (74)[18] found that the ganglion cells in the central area of the retina behave slightly differently. Not only does the responsiveness of the field centre decrease, but also that of the periphery, to the point where the cell will no longer respond. They found that the response of these cells can be abolished altogether by only a small error of refraction (usually less than 8 dioptres).

In other words the foveal neurones in the retina require well focussed stimuli in order to respond effectively. If the same characteristics apply to human ganglion cells, this could possibly result in eccentric fixation. Higher refractive errors could play an important part in the aetiology of bilateral eccentric fixation as shown in this survey where 44% of eyes had a retinoscopy of over +6.25 dioptres and a further 8.5% had a retinoscopy of over −2.25 dioptres.

Is 6/6 normal vision?

An observation made by Hermann and Priestley (65)[3] was that the fixing eye of an amblyope, on critical examination, often does not have steady foveal fixation, but rather is unsteady central or parafoveal. They also noted that 6/6 or better vision is rarely reached in the "normal" eye of an amblyope. In this present study, only 50% of amblyopes had steady central fixation in the "normal" eye, and 50% had unsteady or eccentric fixation. Only 197 cases (56.7%) had 6/6 vision or better in the "normal" eye. The significance of this figure is shown when compared to the statistics of a series of normals taken from Brown and Jones (77)[19] where 86.9% of children tested had 6/6 or better vision in one or both eyes.

Kandel *et al.* (77)[20] stated that in a group of amblyopes, the dominant eye frequently demonstrates a minute amount of eccentricity that is not found in a group of normal eyes. They found that in most normal subjects with central fixation the foveal acuity was 6/4, and therefore superior to the generally accepted standard of 6/6. This being the case, a visual standard of 6/6 could still be attained in the presence of eccentric fixation as can be seen in this survey where 36% of patients with bilateral eccentric fixation had 6/6 vision one eye. The observer should therefore not assume central fixation to be the case without very careful scrutiny, irrespective of vision.

CONCLUSION.

It is apparent that critical examination of the fixation pattern of BOTH eyes of an amblyope, reveals a significant incidence of bilateral eccentric fixation (11.2%).

Various theories have been postulated to explain this phenomenon.

Neonatal macular haemorrhage has been cited as a possible cause however, surveys following up babies with this condition have found no results to support this theory.

Lack of retinal development, e.g. foveal hypoplasia, could explain bilateral amblyopia especially in cases of high hypermetropia (Duke Elder[13]) and the resultant eccentric fixation.

In this survey, the presence of a significant refractive error could explain the bilateral eccentric fixation in a marked number of cases (44% had a retinoscopy of +6.25 or over). It can be seen from the results, and Abraham (64)[16] also found that there is no direct relationship between the best achieved vision and the age at first correction. Thus if a significant refractive error is present, bilateral amblyopia and eccentric fixation could result, even with EARLY correction. Experiments conducted by Hill and Ikeda (71)[17] and Ikeda and Wright (74)[18] could possibly explain how this eccentric fixation results when higher refractive errors are present.

Following Mein (75)[7], if bilateral eccentric fixation is present even if there is no demonstrable squint, microtropia with identity could be a bilateral phenomenon. As some patients have shown in this survey, it is possible even to have a simultaneous or bilateral microtropia.

A question that arises is whether the "normal" eye of an amblyope is the same as the normal eye of a normal subject. Kandel *et al.* (77)[20] have shown that a normal eye's fovea can attain a visual level of 6/4. Therefore, the previously accepted standard of 6/6 could still be achieved in the presence of eccentric fixation. In the light of this study, it would seem apparent that the fixation pattern of BOTH eyes of an amblyope should be carefully examined and re-checked at each visit, irrespective of visual acuity.

Thus in the amblyopic patients we treat, can we make the assumption of "normal" and "amblyopic" eye? Also I feel that the criteria of "fixing" eye and "normal vision = 6/6" should be challenged.

I wish to thank my colleagues for making their patients available for this survey and for their help in preparing this paper. I would also like to thank Dr J. Hornbrook for arranging for a Medlars Search, which proved so valuable in my research.

REFERENCES.

1. von NOORDEN, G. K., and MACKENSON, G., "Phenomenology of Eccentric Fixation", Am. J. Oph., 62: 642-661, (1962).
2. von NOORDEN, G. K., "Bilateral Eccentric Fixation", Arch. Ophthal., 69: 25-31, (1963).
3. HERMANN, J. S., and PRIESTLEY, B. S., "Bifoveal Instability, The Relationship to Strabismic Amblyopia", Am. J. Oph., 60: 452-459, (1965).
4. MALIK, S. R. K., SOOD, G. C., GUNGULI, G., and SINGH, G., "Bilateral Eccentric Fixation", Brit. J. Oph., 52: 153-156, (1968).
5. MALIK, S. R. K., SEN, D. K., and CHOUDRY, S., "Pathogenesis and Management of Bilateral Eccentric Fixation", Indian J. Oph., 20 (1): 4-10, (1972).
6. GUPTA, S. D. and SOOD, S. C., "Microstrabismus with Bilateral Eccentric Fixation – A Case Report", Indian J. Oph., 21 (2): 66-67, (1973).
7. MEIN, J., "Bilateral Eccentric Fixation", Brit. Orthop. J., 32: 14-20, (1975).
8. ENOCH, J. M., "Receptor Amblyopia", Am. J. Oph., 48: 262-274, (1959).
9. BURIAN, H. M., in discussion, Enoch, J. M., Ibid.
10. von NOORDEN, G. K. KOUDADOUST, A., "Retinal Haemorrhages in Newborns and Organic Amblyopia". Arch. Ophthal., 89: 91-93, (1973).
11. LOWES, M., EHLERS, N., and KARUP, J., "Visual Functions After Perinatal Macular Haemorrhage" Acta Ophthal., 54: 227-232, (1976).
12. DUKE-ELDER, Sir S., Ed., Systems of Ophthalmology, Vol. V, Ophthalmic Optics and Refraction, London, Henry Kimpton, 1970, pp. 255-287.
13. DUKE-ELDER, Sir S., Ed., Systems of Ophthalmology, Vol. III, Normal & Abnormal Development, Part II, Congenital Deformities, London, Henry Kimpton, 1970, p. 653.
14. CURRAN, R. E., and ROBB, R. M., "Isolated Foveal Hypoplasia", Arch. Oph. 94: 48-50, (1976).
15. YOSHIZUMI, M. O., THOMAS, J. V., and HIROSE, T., "Foveal Hypoplasia and Bilateral 360-degree Peripheral Retinal Rosettes", Am. J. Oph., 87: 186-192, (1979).
16. AGRAHAM, S. V., "Bilateral Ametropic Amblyopia". J. Ped. Oph., 1: 57-61, (1964).
17. HILL, R. H., and IKEDA, H., " 'Refracting' a Single Retinal Ganglion Cell", Arch. Ophthal., 85: 592-596, (1971).
18. IKEDA, H., and WRIGHT, M. J., "Is Amblyopia due to Inappropriate Stimulation of the 'Sustained' Pathway During Development?". Brit. J. Oph., 58: 165-175, (1974).
19. BROWN, S., and JONES, D., "A Survey of the Incidence of Defective Vision and Strabismus in Kindergarten Age Children – Sydney 1976". Aust. Orth. J., 15: 24-28, (1977).
20. KANDEL, G. L., GRATTEN, P. E., BEDELL, H. E., "Monocular Fixation and Acuity in Amblyopic and Normal Eyes", Am. J. Optom., Phys. Opt., 54: 598-608, (1977).

CASE REPORT: BILATERAL MICROTROPIA WITHOUT IDENTITY

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Abstract
The fixating pattern of the deviating eye in microtropia and its application to bilateral eccentric fixation is discussed. A case of bilateral microtropia with bilateral eccentric fixation, with the results of standard and additional tests is presented.

Key words
Microtropia, bilateral eccentric fixation.

Lang[1] has described three types of fixation pattern of the deviating eye in microtropia:

i) central fixation
ii) eccentric fixation without identity with the angle of anomaly (i.e. there is an incomplete movement to cover test)
iii) eccentric fixation with identity (i.e. there is no movement to cover test)

When considering bilateral eccentric fixation, Mein[2] stated "If bilateral eccentric fixation does occur in cases of bilateral amblyopia without a manifest deviation on cover test and with demonstrable binocular single vision, then it would appear that microtropia with identity can occur bilaterally and is not confined to one eye as hitherto described by von Noorden and other authors".

Recently we have observed several patients who have demonstrated bilateral microtropia without identity, that is, a movement can be detected when either eye takes up fixation on cover test without maintaining this fixation. Some of these deviations have become obvious only after occlusion of the "fixing" eye in cases of bilateral eccentric fixation.

The aim of this paper is to present a case of bilateral microtropia and eccentric fixation without identity.

Master D.B., age 7 years, presented at Sydney Eye Hospital, as, on medical examination at a receiving centre, he was found to have reduced vision in each eye. He was referred for refraction to the general clinic and then to the orthoptic clinic for assessment and supervision of treatment.

No accurate history was available as the child was a ward of the state. The patient said that he had previously worn glasses but had lost them.

Examination

After refraction under cycloplegia, glasses (R–3.75/+3.75 x 105, L–2.75/+1.75 x 80) were ordered and worn. Fundi and discs were normal.

Cover test with glasses revealed a R microesotropia with a simultaneous L microesotropia. Ocular movements and convergence were normal. Stereopsis measured 50 seconds of arc on the Titmus stereo test. Visual acuity, with glasses was R6/9 (part), N8, and L6/6 (slowly), N6. On monocular visuscopy the right eye was fixing parafoveally in the temporal inferior area, and the left eye was fixing parafoveally in the nasal inferior area. The 4^{Δ} test proved inconclusive.

Left lens occlusion (2 hours per day) was ordered to try to improve the right visual acuity, but was discontinued when the vision failed to improve.

During the following months of observation, some more specialised tests were performed.

Fields were full to confrontation testing. Haidinger's brushes were projected nasally with each eye. The Farnsworth Munsell 100 Hue Colour Test was within normal limits.

At the last visit, ten months after the first, the results of the orthoptic examination (including visual acuity) were unchanged. The responses to the tests were confirmed by my colleagues in the orthoptic department.

REFERENCES
1. LANG, J. "Microtropia" Arch. Ophthalmol. 81:758 1969.
2. MEIN, J. "Bilateral Eccentric Fixation" Brit. Orth. J. 32:14-20. 1975.

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AN EVALUATION OF PROXIMAL CONVERGENCE BY THE USE OF INFRA-RED PHOTOGRAPHY

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Abstract
Convergence of the eyes was measured photographically in two situations:
i) in normal illumination, at distances from 50cms to 10cms
ii) in the dark, by use of infra-red photography. The subjects were instructed to hold the target at the above distances and imagine that they were looking at it.
It was demonstrated that the measurements obtained in the light approximated well with the predicted hyperbolic curve, the formula C = 2D being adequate enough to account for 98% of the variability in the measurements.
Measurements in the dark also resulted in this high degree of agreement with the theoretical curve. However, comparison of the measurements taken in the dark with those in the light showed that the convergence response in the absence of visual clues is strong and is frequently in excess of the required convergence. It is suggested that this is due to proximal convergence which may play a greater role in the position of the eyes for near than has been demonstrated previously.

Key words
Proximal convergence, AC/A ratio, infra-red photography.

Introduction

The stimuli to a convergence response have been traditionally described as:

1. Muscle tonus, bringing the eyes from the anatomical positions of rest (i.e. divergence) to the physiological position of rest (approaching parallelism)
2. Laterally displaced similar retinal images, stimulating a corrective fusional vergence reponse
3. Accommodation, stimulating a convergence response. The amount of convergence (in prism dioptres) per dioptre of accommodation is expressed as the AC/A ratio.
4. Knowledge of proximity, stimulating convergence in response to the perceived nearness of an object.

Tonic convergence is usually considered to be constant throughout standard clinical measurements and these measurements usually include dissociation to prevent fusion. Therefore the two variables in the difference between distance and near deviations must be accommodative convergence and proximal convergence.

However, when considering the near deviation, any change is often attributed to the AC/A ratio alone. If the deviation is more convergent for near the AC/A ratio is considered to be high, and low if the deviation is less convergent for near[1]. However, Rubie[2] reports that there appears to be little correlation, in many cases, between the AC/A ratio measured by the gradient method and that predicted by a comparison between distance and near deviations.

This study investigated the position of the eyes when, by the absence of visual clues, a direct stimulus to accommodation is also eliminated. The resulting convergence is considered to be proximal convergence.

Many studies have been made on the AC/A ratio, giving it a value of approximately 3.5 to 4 prism dioptres per dioptre of accommodation[3].

Proximal convergence has received far less investigation, but at least three different ways of measuring it have been described.

1. By comparison of the AC/A ratio measured by the 'heterophoria' and 'gradient' methods[4,5].

The distance and near deviations are compared to determine any additional convergence for near (heterophoria method). Since this method must include some proximal convergence, that measurement taken at a fixed distance but with accommodation altered by the use of lenses (gradient method) is subtracted to give a measurement of that induced by nearness only. Such studies give a value of proximal convergence of approximately 1△ at one metre.

However, a criticism must be made of this method of determination. It assumes that the effects of accommodative convergence and proximal convergence must be *summative,* i.e. that each stimulus contributes a certain amount of convergence and that the two can be added to give the final convergence measurement.

There are many physiological systems in which two stimuli may act together to produce a common response. However, should each stimulus act individually the sum total of the responses may be in excess of the response if they act together. For example, the eyes make a saccadic movement to the side in response to a combined acoustic and visual stimulus, however the speed and accuracy of this movement will be much the same if only one stimulus was operating. It would seem that proximal convergence should be measured directly to evaluate its effect and *not* by the subtraction of the effect of the AC/A ratio.

2. By comparison of major amblyoscope measurements with the distance prism and cover test measurements. This may be termed instrumental convergence (which cannot be expressed as a unit per unit of distance). This response has been found to be highest in patients with esotropia, but that the method undervalued the near response if compared with that determined by the heterophoria and gradient methods[6].
3. By determining the convergence response when accommodative requirements are eliminated by plus lenses, as described by Schapero and Levy[7]. The authors found that proximal convergence had a value of approximately 3△ at one metre. The response per unit of distance decreased at closer range, being 4.6△ at 33cms.

   It appeared that proximal convergence did not show a linear relationship to the reciprocal of the distance (in metres) as accommodative convergence shows to each unit of accommodation. A criticism can also be made of this, and other similar methods in that the relaxation of accommodation through plus lenses is difficult, and has been found to be even less accurate and efficient than accommodation induced by minus lenses[4,8].

The fact that presbyopes do not show an increase in exophoria for near with the onset of presbyopia although their ability to accommodate is reduced, is a well known clinical finding and has been demonstrated by Sheedy and Saladin[9]. They, and others[10] have suggested that this is due to the fact that the presbyope still attempts to accommodate, bringing about the required convergence. However, such an accommodative response would have to be remarkably accurate to give the stable near readings usually found, and such accuracy has been found to be lacking when a blurred image is received[8]. Moreover, presbyopes are normally wearing a near addition so that a clear image is received, giving no accommodative stimulus.

Brienin and Chin[11], by studying the accommodative response in presbyopes, found that their subjects accepted blur and did not make excessive attempts to accommodate.

One could conclude that, if convergence for near is not provided by accommodative convergence, then proximal convergence may play a significant role.

To study the effects of proximal convergence, one should ideally have a situation where all stimuli to accommodation and fusion are absent. One way of achieving this is to evaluate convergence induced by non-visual stimuli, in total darkness. This is possible by the use of infra red photography and was used in the following study.

Method

1. Normal photographs (i.e. in the light) were taken of 16 subjects converging at the specific distances of 50cm, 33.3cm, 25cm, 20cm, 16.6cm, 12.5cm and 10cm. (i.e. 1/2, 1/3, 1/4, 1/5, 1/6, 1/8, 1/10 metres). (See Figure 1) All of the subjects were non presbyopic with bifoveal fixation at each distance.
2. The photographs were enlarged and the interlimbal distance was measured. As each subject was fixing bifoveally it was assumed that such a measurement could be directly related to the known convergence at each particular distance. Because the inter pupillary distance varied between subjects the amount of convergence in metre angles (M.A.) is shown on the ordinate of the graph, remembering that a metre angle refers to the convergence of *each* eye at one metre, therefore total convergence at one metre is actually 2 M.A.[11] The average I.P.D. of the

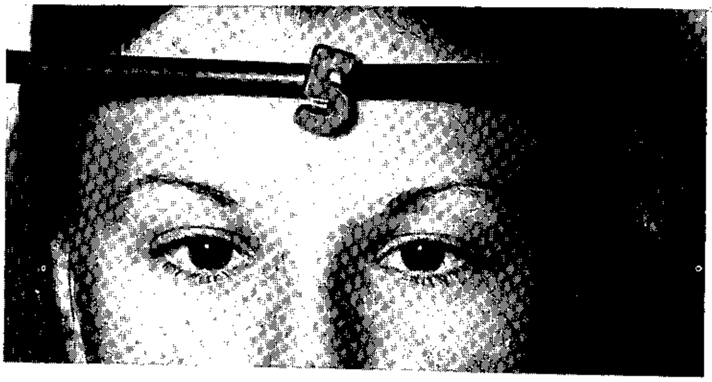
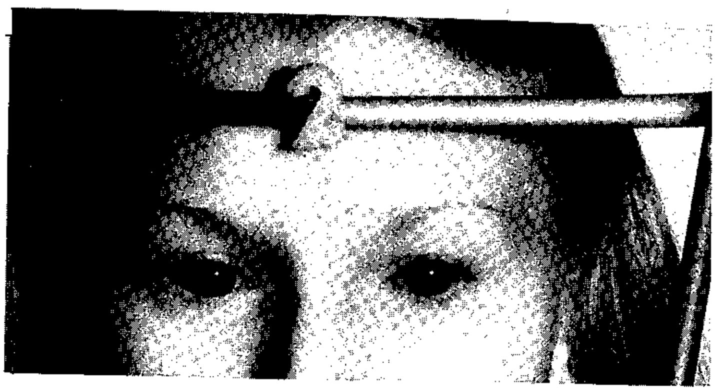


FIG. 1

FIG. 2



subjects was 6.2cms and the equivalent convergence in prism dioptres is included in brackets. Because this method proved to be a suitable way of measuring convergence (see results) the resultant measurements could then be used as a basis on which to evaluate those measurements taken in the dark.

3. The photographs were repeated at exactly the same distance in total darkness, using infra red photography, whilst the subjects were asked to reach out and touch the target and imagine that they were looking at it. (Figure 2)
   Therefore the only clues to its distance were from the proprioceptive receptors in the arm. Surprisingly, most subjects, although unsure of their ability to do this when it was first explained, found that it did not seem to be difficult to perform. The head was kept steady by a head rest.
4. The resulting photographs were enlarged to exactly the same amount as those taken in the light. Again, the interlimbal distance was measured, and by comparing it with that obtained in the light, the proximal convergence could be measured.

Results

Measurements in light were obtained whilst fusion was acting. These data were converted to metre angles and plotted against the distance from the eyes, in centimetres, of the target. The results of this plot can be seen, along with the curve of best fit, in Figure 3.

The parabolic curve of best fit, shown in Figure 3, has, as its equation

$$C^1 = \frac{3.3}{D + 0.05} - 2 \qquad (1)$$

where C^1 is the convergence in metre angles, and
D is the distance of the object from the eyes in metres.

As pointed out earlier the theoretical curve is

$$C = 2/D \qquad (2)$$

but comparison of the mean observed convergence measurements with those predicted from equation (2) yielded a correlation coefficient of 0.09 ($p < 0.005$). Thus, variations between values obtained from equations (1) and (2) for the same value of D being significantly different due to anything other than chance has probability of 1/200 for the specified range of D, i.e. less than 0.50 metres. Differences between the observed values of C and the theoretical values of C are consequently

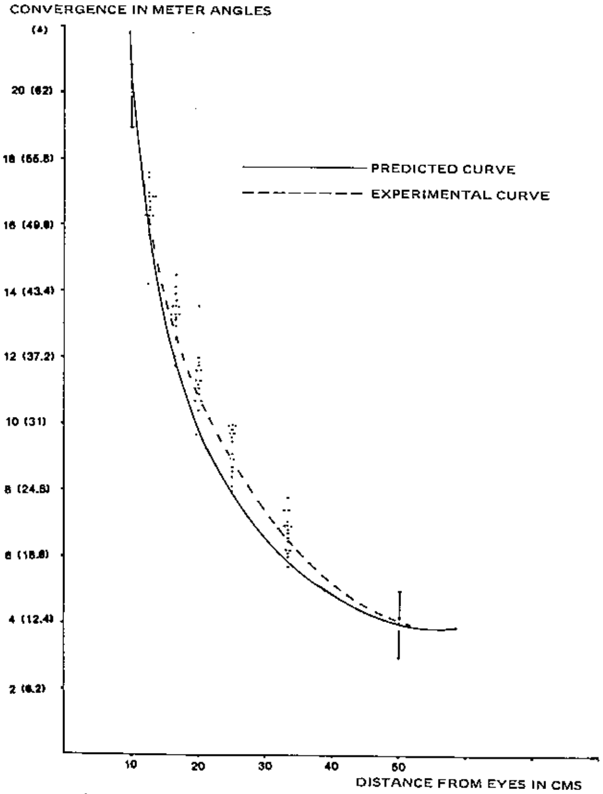


FIGURE 3 CONVERGENCE IN THE LIGHT

well within the bounds permitted by sampling error.

Data obtained from measurements of convergence in the dark are plotted in Figure 4 and 5. In Figure 4 the curve of best fit, parabolic, has been drawn along with that obtained for convergence in the light. The equation of the latter is given above, equation (1), while the equation of the former is

$$C^1 = \frac{2.58}{y + 0.05} + 1.318 \qquad (3)$$

The mean values with standard deviations for each distance are shown in Figure 6.

Some observations can be noted from the data presented in Figure 4 and 5:

1. While the curve of best fit is parabolic, there is, on the part of the subjects, a tendency in the dark to show a stronger convergence response for distances 50cm – 12 cm. For distances less than 12cm the "dark" response is more reduced. Although, overall, showing a greater response than for "light" again the values from the theoretical curve, equation (2) correlate largely ($r = 0.99$, $p < 0.005$) with the observed mean values.

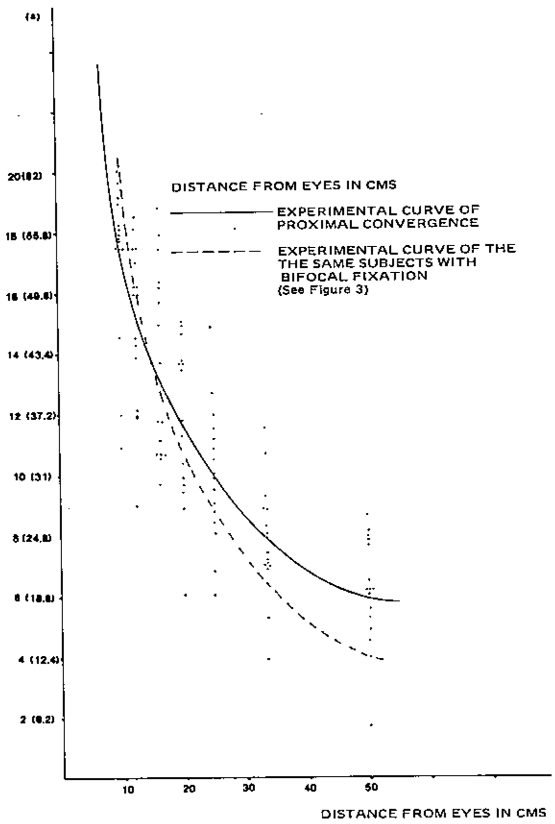


FIGURE 4 PROXIMAL CONVERGENCE

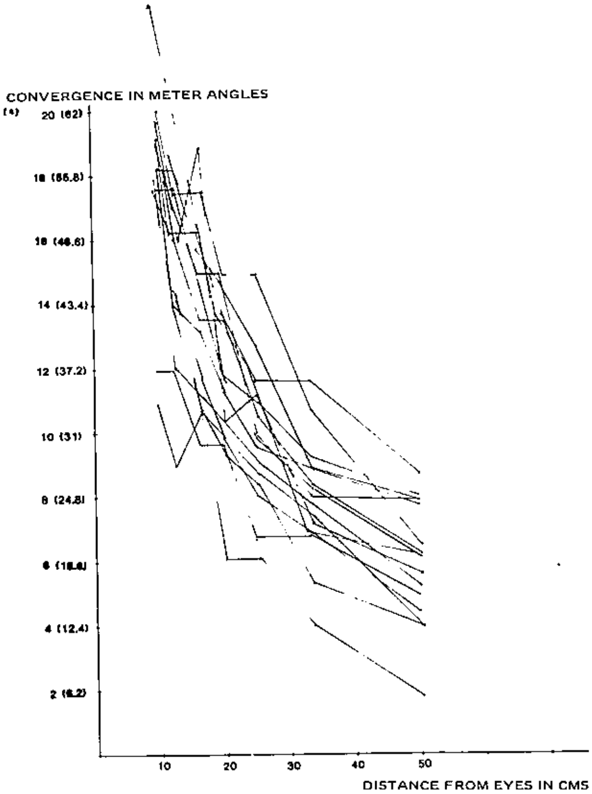


FIGURE 5 INDIVIDUAL RESPONSES TO PROXIMAL CONVERGENCE

DISTANCE	50 cms	33.3cms	25cms	20cms	16.6cms	12.5cms	10cms
Equivalent dioptres of accommodation	2	3	4	5	6	8	10
Mean (Δ)	18.5	24.5	31.1	35.7	43.8	46.6	57
Standard Deviation (Δ)	5.8	5.7	6.9	8	9.2	8.3	11.6

FIGURE 6 Mean values and standard deviations of measurements of proximal convergence

2. For individual data obtained in the dark there is a much wider scatter of values of C^1 for any given value of D. This can be seen in Figure 4 and is supported by the fact that for predicted data the error mean square is 0.3741 for the dark and 0.0632 for the light. Altogether there does exist a large variability between individuals in the "dark" responses, Figure 5 illustrates that within individuals the performance is consistent for each distance (D). Variations between individuals can be likened to individual variations in the AC/A ratio.
3. The pattern of reduced response for close distances described above is supportive of the findings of Schapero and Levy[6]. The fact that the eyes tend to take up a slight convergent angle for distance in the absence of visual clues is a well known fact (space myopia). This may also be a manifestation of proximal convergence as it is probable that the more normal position of 'relaxed' fixation in everyday life is around 5 – 6 metres, rather than infinity.

4. For thirteen of the subjects, proximal convergence measured by this technique was, at least for the further distances, in excess of the required convergence, although these subjects did not normally show an esophoria. This could be explained by at least two factors:
   i) That proximal convergence is a vigorous response to nearness which is modified in the normal environment by the more accurate visual clues to proximity such as perceived size and the relationship of objects to others. Information derived from accommodation may also modify its response.
   ii) That the judgement of distance by this technique, i.e. from proprioceptive clues from the muscles of the arm, was inaccurate.

Nevertheless, the dramatic response of convergence in the absence of accommodative clues and fusion, does indicate a greater importance of proximal convergence in the near deviation than has been described by previous techniques.

CONCLUSIONS

Proximal convergence, as measured by the technique described above, shows stronger response than previously predicted for near. This conclusion is supported by the data obtained for distances at 33.3cm (at which near measurements are taken) which yield a mean convergence of 7.9 M.A. (24.5△) with a standard deviation of 1.79 M.A. (5.7△).

As the distance of the target from the subject is increased the response is still in excess of that required at 50cm. This pattern is also repeated for the distances 25cm, 20cm and 16cm. For distances closer than 16cm the mean convergence obtained was less than that predicted.

Although some variations from what had been predicted have been obtained, the overall pattern for proximal convergence agrees with what had previously been predicted. This paper has presented a technique whereby measurements can be obtained in the total absence of visual stimuli.

Acknowledgement

Full acknowledgement is given to David Robinson, photographer at Cumberland College. Without his professional expertise this research would have been impossible.

REFERENCES

1. PARKS, MARSHALL M. "Ocular Motility and Strabismus". Harper and Row, Maryland, 1975. p. 61
2. RUBIE, CHRIS. "The effect of the AC/A ratio on the difference between distance and near measurements of deviation". Aust. Orth. J. 1979-80. 17
3. DUKE ELDER, S. and WYBAR, K. "System of Ophthalmology" Vol. VI. Ocular Motility and Strabismus. Henry Kimpton, London, 1973. p. 208
4. OGLE, K. W., MARTENS, T. G., and DYER, J. A. "Oculomotor Imbalance in Binocular Vision and Fixation Disparity". Lea and Febiger, Philadelphia, 1967. p. 121-142
5. ARNOTT, E. J. and O'CALLAGHAN, K. T. "Further investigations of the AC/A ratio". Brit. Orth. J. 1971. 28 : 11
6. FRANCESCHETTI, A. T., and BURIAN, H. M. "Proximal Convergence" Transactions of the Consilium European in Strabismi Studio Deditum Congress, London, Henry Kimpton, London. p. 125
7. SCHAPERO, M. and LEVY, M. "The variation of proximal convergence with change in distance". Am. J. Optom. 1953, 30, 403
8. OTTO and SAFFRA. "Orthoptics, Past, Present and Future". Eds. Moore, Mein and Stockbridge, Symposia Specialists, Miami, 1976. p. 45
9. SHEEDY, J. E., and SALADIN, J. J. "Exophoria at Near in Presbyopia". Am. J. Optom and Physiol. Optics. 1975. 52, 474
10. MARTENS, T., and OGLE, K. "Observations on accommodative convergence". Am. J. Ophthalmol. 1959. 47 : 455
11. BREININ, G. M., and CHIN, N. B. "Accommodative convergence and ageing". Doc. Ophthalmol. 1973, 34, 109
12. DUKE ELDER, S. and WYBAR, K. "System of Ophthalmology" Vol. VI. Ocular Motility and Strabismus. Henry Kimpton, London, 1973. p. 171

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THE INFLUENCE OF ORTHOPTIC TREATMENT ON PROXIMAL CONVERGENCE

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Abstract
Proximal convergence in a subject with convergence insufficiency was measured before and after treatment by a method previously explained. It was demonstrated that this response improved after treatment. It is suggested that, since proximal convergence is a learned response, it may be more amenable to training than accommodative, fusional or tonic convergence.

Key Words
proximal convergence, convergence training, AC/A ratio, infra red photography

Introduction

Orthoptists spend a large proportion of their time altering a convergence response in patients with latent or intermittent deviations. The most common example of this is in cases of convergence insufficiency, which, as is well known, responds quickly to convergence training.

However, it is worthwhile to ask exactly what is improved by these exercises. Arnott and O'Callaghan[1] suggest that the tone of the medial rectus muscles is improved, and this, indeed, is the explanation frequently given to patients. However, if monocular adduction exercises were given instead of convergence exercises, the medial rectus would still be innervated, but it would be doubtful if convergence would be improved.

Although, in some cases, accommodation which appears 'sluggish' improves with treatment giving extra accommodative convergence, it is unlikely that the AC/A ratio is altered by this treatment.

The most favoured explanation, especially from orthoptic text books is that the patient's fusion range is improved. However, one must be specific in the use of the term fusion. Fusion, if not innate, is at least well established during infancy. True fusion is an involuntary function. The improved 'fusion' ranges demonstrated at the synoptophore or with prisms after training undoubtedly include voluntary convergence, as the patient consciously tries to keep the images joined. Fusion may be allowed to act more efficiently by the removal of barriers to its action such as suppression or a patient's aversion to convergence, but it is unlikely that an innate function could be so dramatically altered by a few exercises at home and in the clinic.

Proximal convergence is obviously a conditioned response which develops as we learn from our experience how far away from us objects are. Proximal convergence is perhaps also evident in voluntary convergence, as one imagines that an object is close to the eyes. Certainly, each of these types of convergence is based on learning, and could be more logically altered by simple training.

Although cases of convergence excess are generally attributed to a high AC/A ratio, von Noorden[2] demonstrated that, in a certain proportion of these cases, the AC/A ratio was normal. He suggested that there could be an altered response of tonic convergence for near. However, it is also possible that proximal convergence could be acting excessively. It has been observed during practice that some such cases do lose the excessive near convergence after simple relaxation exercises.

The previous paper has described a technique of evaluating proximal convergence by the use of infra red photography, so that fusional and accommodative clues are eliminated.

This technique was also used to evaluate the effect of orthoptic treatment on the proximal response of a subject with convergence insufficiency.

Method

Photographs were taken, both in the light and, (by the use of infra red photography) in the dark of a subject (RG) converging from 50cms to 10cms from the eyes. In the dark, the subject was told to hold the object and imagine that she was looking at it. The photographs were enlarged and the measurements taken of the interlimbal distance as previously described.

Her response is shown in Figure 1, compared with the average response in the dark found from sixteen symptom free subjects, with their upper and lower limits.

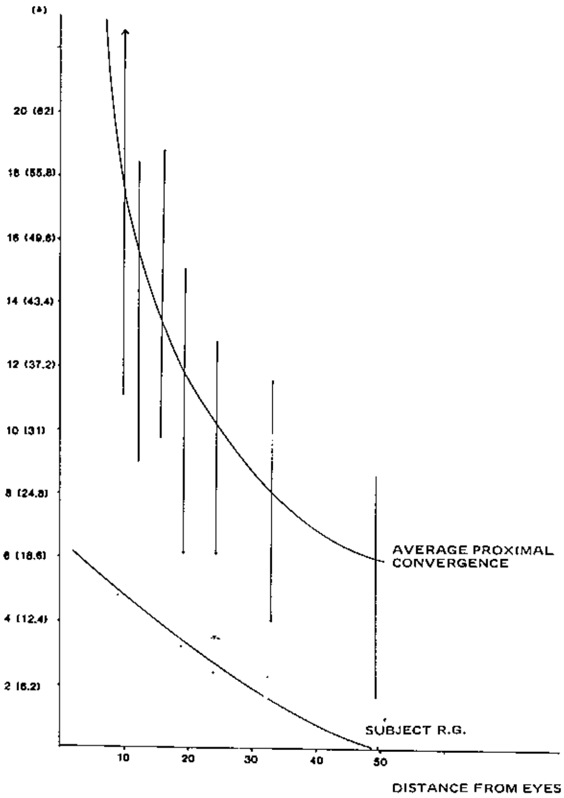

FIGURE 1 PROXIMAL CONVERGENCE BEFORE TREATMENT

It is clear that her response was well below even the lower limits of the symptom free group.

Her convergence near point was 14cms, with a reduced accommodation amplitude. Her range of convergence on the synoptophore was from –3° to +8°.

Standard orthoptic treatment was given, consisting of simple convergence exercises as the target was brought closer to the eyes, followed by the development of voluntary convergence and relative fusion with stereograms.

After treatment her convergence near point was 7.5cms, accommodation was normal, and the synoptophore range of convergence was –4° to +20°. Her standard was still below that normally aimed for, but, since she had been symptom free for several visits the course of treatment was stopped.

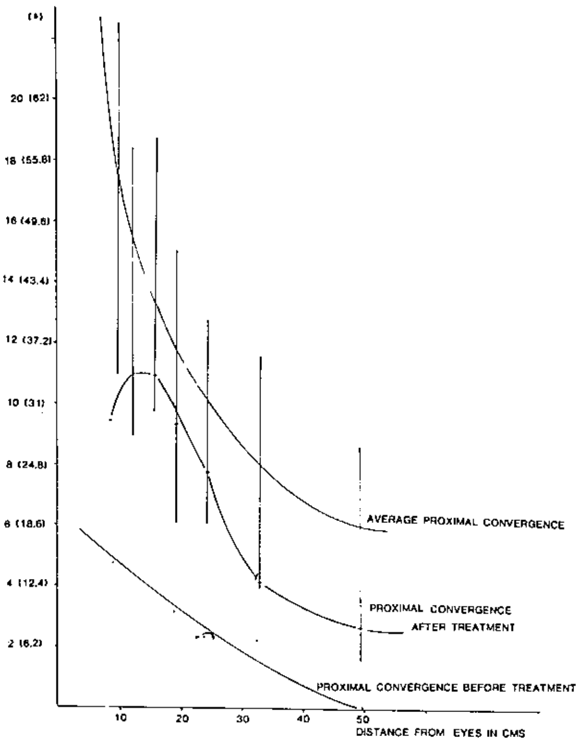

FIGURE 2 PROXIMAL CONVERGENCE BEFORE AND AFTER TREATMENT

Measurements of proximal convergence were repeated, and are shown in Figure 2. It is obvious that her proximal response has improved and is now within the lower limits of the normal population. The 'dropping off' effect at the nearer distances was not surprising as her convergence near point was still not well maintained.

Infra red photographs of her proximal convergence before and after treatment are shown in Figure 3.

Discussion

Orthoptic treatment has altered the proximal convergence response in this particular subject with convergence insufficiency.

Figure 3.
Subject (R.G.) converging to 20 cms (1/5 m) in the light (top) and attempting to converge to the same distance before (centre) and after (bottom) treatment.

It is possible that this response may be altered on other types of latent or intermittent strabismus, most notably in those cases of convergence excess where a high AC/A ratio is not present.[1]

It is obvious that further cases should be studied to define more accurately the modification of this response from treatment.

REFERENCES
1. ARNOTT, E. J. and O'CALLAGHAN, K. T. "Further Investigation of the AC/A Ratio" Br. Orth. J. 1971, 28 : 1
2. VON NOORDEN, G. K., MORRIS, J., and EDELMAN, P., "Efficacy of Bifocals in the Treatment of Accommodative Esotropia" Am. J. Ophthal. 1978, 85 (6)

THE EFFECT OF DARKNESS ON THE MIOSIS ASSOCIATED WITH THE NEAR REFLEX

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Abstract
Research was undertaken to investigate the pupillary constriction associated with the near reflex and to demonstrate the effect of darkness upon this reflex.

It was found that there exists a linear relationship between convergence and pupillary constriction and that this same relationship is present even in total darkness. It is suggested that it must be either proximal or voluntary convergence which is utilised in total darkness to initiate the miosis occurring on near fixation. The available evidence in literature supports this conclusion.

Key words
Miosis, near reflex, infra red photography, proximal convergence, voluntary convergence

As a result of recent research [1] into the effects of proximal convergence upon near fixation it has become apparent that there is scope for investigation into the related near reflex, in particular the miosis occurring on near fixation.

Thus the aim of the paper is to investigate the pupillary constriction associated with accommodation and convergence, and to demonstrate its effect in the dark.

Normally, when an individual alters fixation from a distant object to a near object, the eyes converge, accommodation takes place, and the pupils undergo an equal amount of constriction. This relationship that exists between accommodation, convergence and miosis is known as the near reflex, although many authors (including Adler[2], Newell[3] and Walsh and Hoyt[4]) agree that the relationship is not a true reflex but a synkinesis, as it is possible to demonstrate miosis when either convergence or accommodation is abolished. Convergence may be selectively eliminated by the interposition of base-in prisms before each eye so that on fixation of a near target accommodation and miosis occur alone. Accommodation may be selectively eliminated by placing appropriate convex lenses before each eye so that, as one converges to a near target, miosis occurs but accommodation is inhibited.

Knoll[5] states that "when the eyes are made to converge with accommodation kept fixed there is some pupillary constriction but very small by comparison with that which would occur were accommodation permitted to match the convergence". Knoll expresses the view that it is primarily accommodative convergence which initiates miosis. According to Alpern, Ellen and Goldsmith[6] the pupil continues to constrict even when the amplitude of accommodation has been exceeded. They feel that the effort to accommodate is sufficient to cause pupillary constriction.

Marg and Morgan[7] in 1950 investigated the proximal pupillary factor in relation to the near reflex. Under conditions of normal illumination they found no evidence to support the existence of such a factor. Morgan's later research[8] studied the pupil size in the 'dark' in relation to the near reflex. However, throughout the experiment the fixation target was illuminated, with the result that other factors were present to initiate the miosis, (i.e. accommodation or convergence).

According to Newell[9], the near reflex is related to vergence movements involving the visual response to the awareness of the nearness of an object. He states that it may occur without visual response when an individual converges for the distance he believes the object to be, basing his judgement on sound or touch.

Pupillary constriction associated with near fixation can be observed on presbyopic subjects and also on uncorrected myopes. Because these individuals do not utilise accommodation on near fixation the miosis which results is not associated with accommodative convergence or even the effort to accommodate, as in an uncorrected myope. Thus, when the influence of accommodation and accommodative convergence are absent on near fixation one must consider other factors which may cause the associated miosis.

It is important to understand that for the normal non-presbyopic individual all three components of the near reflex must be considered as being associated in a common function, and it is only under certain conditions that one may be seen to be dissociated from the other two.

Parkes [10] has defined four stimuli which will produce the synkinetic near response:

1. a blurred retinal image
2. a stimulation of bitemporal retinal elements causing diplopia of the near object
3. an awareness of near
4. voluntary convergence

Because the pupils dilate in the dark, it was of interest to determine the effect of total darkness on this response. Alder[11] states that "this contraction (of the pupils) is independant of any change in illumination."

Method

Nine subjects for study were selected. One could argue that accommodation or convergence anomalies may invalidate the results obtained and thus nullify any conclusions which may be drawn. However, to eliminate this possibility as far as possible, each subject chosen had normal convergence and accommodation. On this basis I have then assumed that the pupils of each subject gave a normal response on near fixation.

Procedure

The subject was seated at a table and requested to place his chin on a chin rest with his forehead against a bar, in an attempt to keep the subject as still as possible, in order to obtain the greatest consistency in the measurements recorded throughout the experiment.

A fixation target, the letter O, was then placed at distances varying between 50 and 10 centimetres from the subjects' eyes (50, 33, 25, 20, 16.5, 12.5, 10 cms). Initially, in normal illumination the subject was instructed to fixate the target at each fixation distance and a photographic record was obtained following the method described by Cornell[1]. The procedure was then repeated utilising infra-red photography after the subject had been dark adapted for several minutes. In total darkness the fixation target was invisible to the subject who lacked any form of visual stimulus to aid the location of the target. The subject was instructed to reach out and to grasp the target and then to imagine he was looking at it. With the absence of visual clues the subject was reliant upon proprioceptive information to locate the target in space relative to the body.

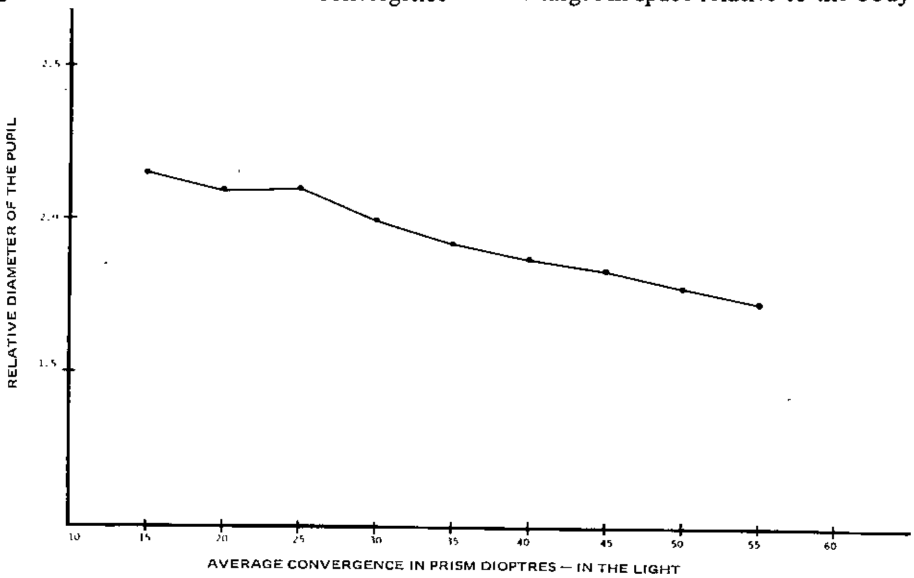

Figure 1. "Pupillary diameter vs convergence in the light"

By taking into account each subjects' inter-pupillary distance it was possible to calculate the amount of convergence which each subject utilised at each fixation distance in the light. By projecting the slides it was possible to obtain a measurement of the pupil diameter at each distance. The basic trend revealed by Figure 1 corresponds with our current knowledge of the miosis associated with near fixation. Overall as the eyes become more convergent the pupillary constriction increases.

A linear relationship was found to exist between the two variables studied. The gradient of the line was found to be –0.011. (y = mx + b). Knowing the equation and gradient of the line it was possible to compute points to give a line of best fit, and when compared to the mean values, they proved to be correct to at least one decimal place.

The readings obtained in the dark for each subject were plotted on their individual graphs in the light, and it was possible to calculate the amount of convergence induced.

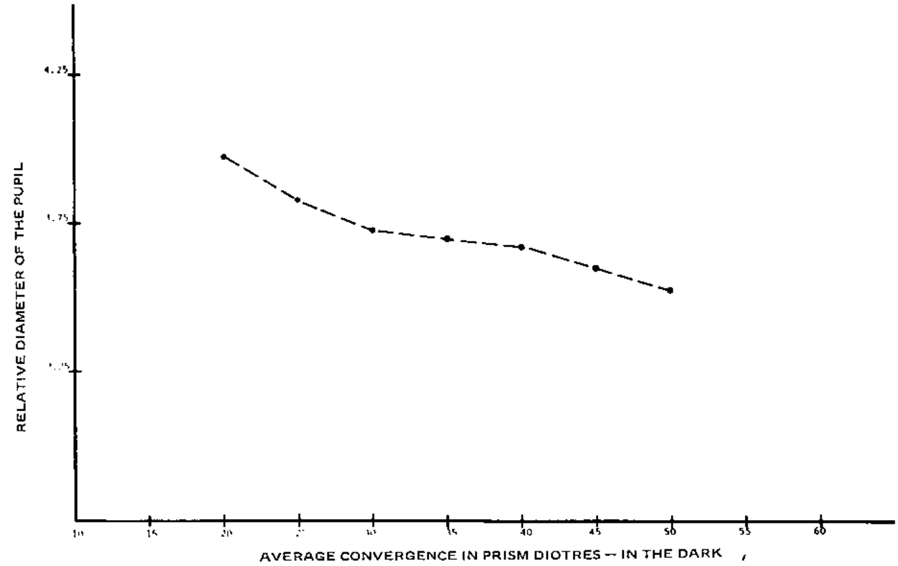

Figure 2. "Pupillary diameter vs convergence in the dark"

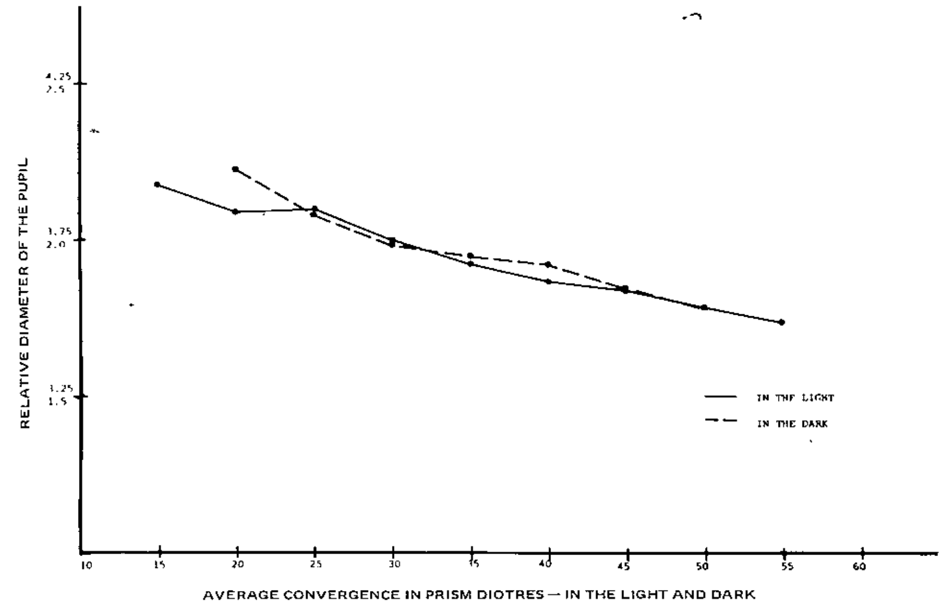

Figure 3. "Pupillary diameter vs. average curves in the light and dark"

This graph shows the mean values for the nine subjects in the dark. Although the pupillary diameters are seen to be proportionately larger in the dark, if one superimposes the two graphs representing the average values in the light and dark, it can be clearly seen that there is a high correlation between the two (Figure 3).

The results in the dark revealed a linear relationship between the two variables. The gradient of the line was found to –0.013. Comparing the two gradients –0.011 (light) and –0.013 (dark) shows that they are the same to two decimal places.

Thus evidence exists to support the supposition that the near reflex operates even in total darkness, which also confirms Adler's statement that the near reflex is not dependant upon constant illumination. However, what remains to be discovered is the mechanism which stimulates miosis in the dark. It is possible that one can exclude accommodation and its associated convergence on the basis that in the dark the subject was not visually stimulated, and therefore, could not perceive blur. Finally, fusional convergence may also be excluded on the basis that in the dark fusion was not stimulated. Hence voluntary and proximal convergence factors remain as the only factors which we can utilise to initiate miosis on near fixation in total darkness.

Acknowledgement

I would like to thank Mrs E. Cornell for her advice and encouragement, and Mr R. Mitchell, from the Department of Behavioural and General Studies, Cumberland College of Health Sciences.

REFERENCES

1. CORNELL, E. "An evaluation of proximal convergence by the use of infra red photography" Aust. Orth. J. 17, 1979
2. MOSES, R. A. Adler's Physiology of the Eye, p. 356, The C.V. Mosby Co, St Louis, 1970
3. NEWELL, F. W. Ophthalmology Principles and Concepts, p. 219, The C.V. Mosby Co, St. Louis, 1969
4. WALSH, F. B. and HOYT, W. F. Clinical Neuro-Ophthalmology, Vol I, 486, Williams and Wilkins, USA 1969
5. KNOLL, H. A. Pupillary changes associated with accommodation and convergence Am. J. Optom. 1949, 26, 346-357
6. ALPERN, M; ELLEN, P. and GOLDSMITH, R. I. The electrical response of the human eye in far to near accommodation. Arch. Ophthalmol. 1958, 60, 592-602
7. MARG, E. and MORGAN, M. W. Jr. Further investigation of the pupillary near reflex, 1950, Am. J. Optom. 27, 217-225
8. MORGAN, M. W. Jr. Relationship between accommodation and convergence. Arch. Ophthalmol. 1952, 47, 745
9. NEWELL, F. W. ibid p. 90
10. PARKS, M. Ocular Motility and Strabismus, p. 59. Harper and Row, Hagerstown, Md 1975
11. MOSES, R. A. ibid, p. 388

THE EFFECT OF THE AC/A RATIO ON THE DIFFERENCE BETWEEN DISTANCE AND NEAR MEASUREMENTS OF DEVIATION

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

Abstract
The influence of the AC/A ratio on the difference between the distance and near deviation is investigated in 248 cases. It is found that the AC/A ratio provides a moderately accurate predictor of the near deviation (± 10△) in cases who are orthophoric at 6m. For all other cases it is of no value. The near deviation in most cases was more convergent than that predicted by the AC/A ratio.

Key words
AC/A ratio, near deviation.

Introduction

It is commonly noted in literature and in clinical practice that the AC/A ratio can be determined by observing the change in deviation from distance fixation to near fixation. For example, it has been stated that "when the measurement for distance and near is equal, the AC/A ratio is normal, when it is greater for distance than near the AC/A ratio is low, and when it is greater for near than distance the AC/A ratio is high".[1]

In the following paper 248 cases were investigated to evaluate the significance the AC/A ratio has upon the variation in angle of deviation from distance to near fixation.

Method

On all patients seen the AC/A ratio was calculated at the synoptophore by the gradient method. This method was chosen as it gives an accurate estimation of the AC/A ratio[2]. Being done at a set distance, the method eliminates any additional effect of proximal convergence on the simulated near deviation and the synoptophore enables the eyes to be kept fully dissociated to eliminate any effect of fusional convergence.

An angle of deviation was first recorded (B) and repeated using −3.00 DS lenses (A) with the better eye fixing in each case. To ensure that the maximum amount of accommodation was exerted the smallest detailed simultaneous perception slides suitable were used, accompanied by constant questioning about fine detail. The AC/A ratio was calculated by the formula $\frac{B - A}{3}$.

The deviations at 6 metres, and 1/3 metre were recorded by means of the alternate prism cover test. The difference between these two measurements was noted with a positive sign indicating a relatively more convergent deviation for near than distance and a negative sign indicating a relatively more divergent deviation for near than distance. For each distance, again to ensure maximum and accurate accommodation, constant questioning about a detailed fixation object was undertaken.

Since all information was obtained from clinical orthoptic assignments, done by students, only 135 of the 248 patients have been recorded with cover tests revealing whether the deviation was latent, intermittent or constant.

In all patients the recordings were taken with the patient wearing the appropriate spectacle correction.

On each graph a line has been drawn showing the predicted values of the difference between the distance and near deviations according to the value of the AC/A ratio alone.

Six centimetres is a convenient average IPD for the general population so that if the subject had an AC/A ratio of only 1, then, for near fixation (1/3m), only 3 dioptres of accommodation is exerted. This then is 15 prism dioptres less than the "ideal" of 18△ at this distance in a subject with an IPD of 6cms. Therefore, the difference in deviation from distance to near fixation should be −15 if the AC/A ratio was determined on the near deviation alone.

In Figure 1, it can be seen that there is no distinct correlation existing between the AC/A ratio and the difference between near and distance measurements. However, a general trend is evident revealing a positive correlation within a difference of fixation measurement range of approximately 20△ or more which tends to be a lot higher than the 10△ accepted as within normal limits by Lyle and Wybar (1970)[1]. As the AC/A ratio moves from low to high most of the patient distribution moves from a relatively more divergent deviation for near than distance to a relatively more convergent deviation for near than distance respectively. The patient distribution also tends to be higher than the theoretical line, suggesting that the factors which are causing the variation are causing a relatively more eso deviation for near.

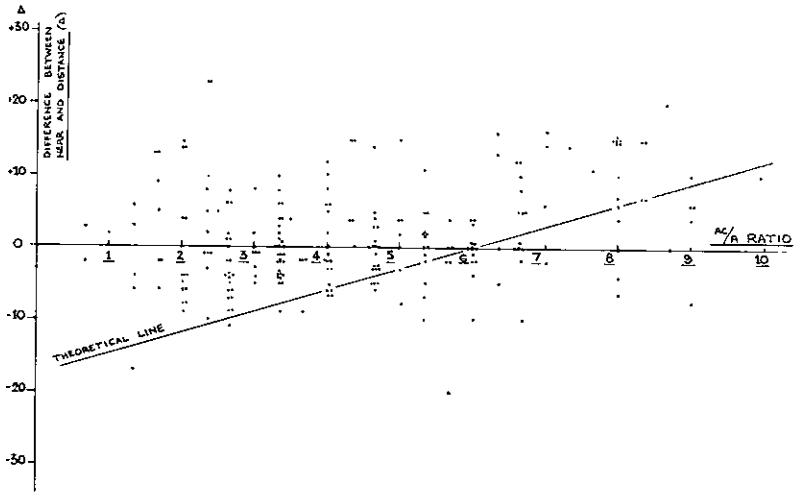

FIGURE 1 ALL CASES (i.e. 248)

Figure 2, evaluating exophoria, shows that 87% of exophoric patients have a more divergent deviation for near than distance. The AC/A ratio ranges from 1 to 7. Only 8% of the exophoric patients were less divergent for near than distance which was unexpected in these particular patients as their AC/A ratios were low. The remaining 5% of patients had no difference between near and distance measurement and had a moderate AC/A ratio.

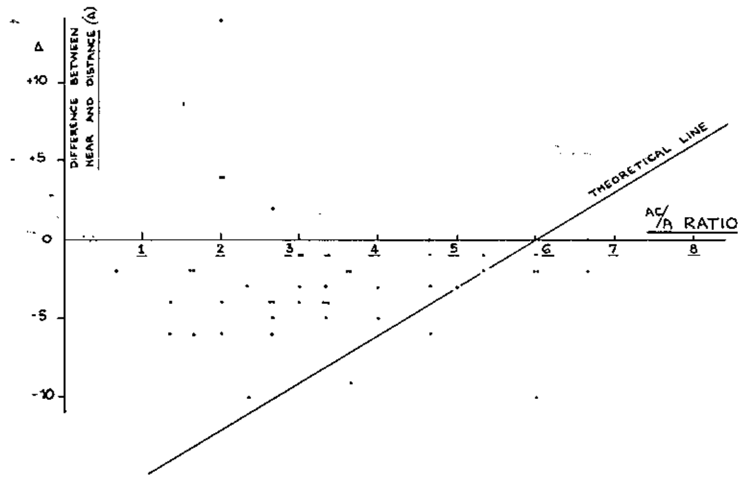

FIGURE 2 EXOPHORIA (47 CASES)

In Figure 3, 5 and 6 no correlation exists at all between the AC/A ratio and the difference between near and distance measurements. All three figures reveal a majority of patients with a more convergent deviation for near than distance, although the AC/A ratio ranged from 1 to 9. In the esophoric and constant squint patients 34% of patients who have a more convergent deviation for near than distance also have a low AC/A ratio. Again, this presents as an unusual finding as one would expect that the majority of this large percentage would have a high AC/A ratio or, conversely, a more divergent angle for near.

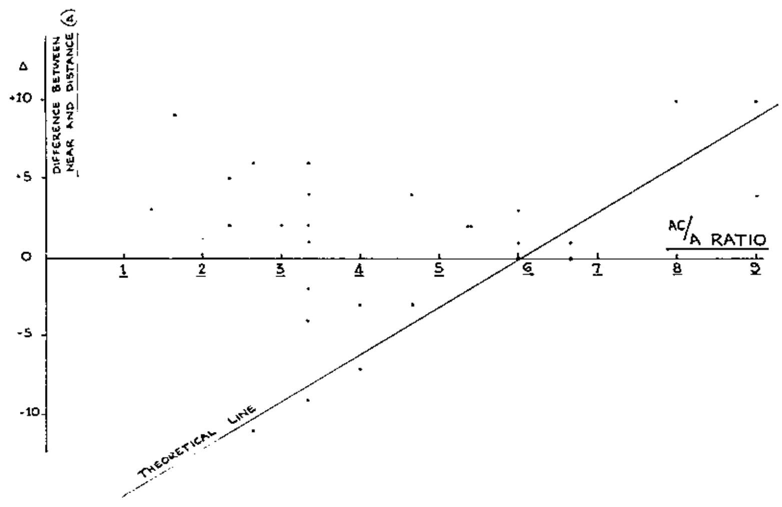

FIGURE 3 ESPHORIA (29 CASES)

In Figure 4 we find the closest correlation between the AC/A ratio and the difference between near and distance measurement. This illustrates those patients who were orthophoric at distance, although they may have had an exophoria or esophoria for near fixation. The range, in expected deviation, does fall within the limits of 10 prism dioptres as predicted by Lyle and Wybar (1970) and the distribution does fall close to the theoretical AC/A ratio line. As the AC/A ratio moves from low to high, the patient distribution moves from a relatively more divergent deviation to a relatively more convergent deviation for near fixation.

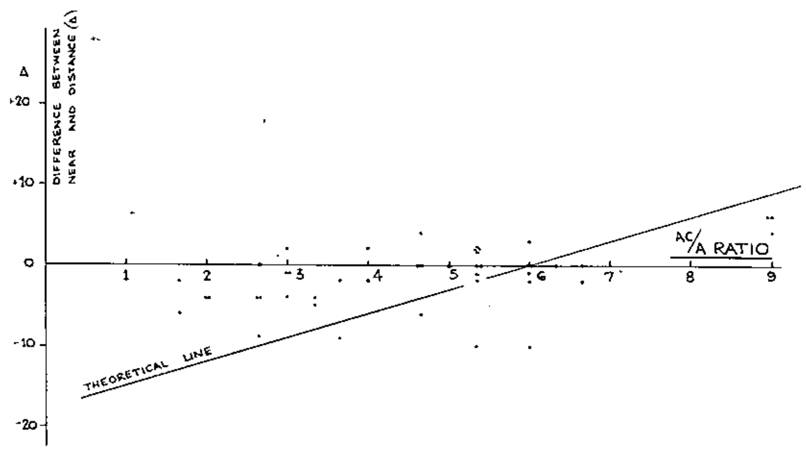

FIGURE 4 ORTHOPHIA AT 6 METRES (45 CASES)
(i.e.) Basic deviation obtained from prism cover test at 6 metres)

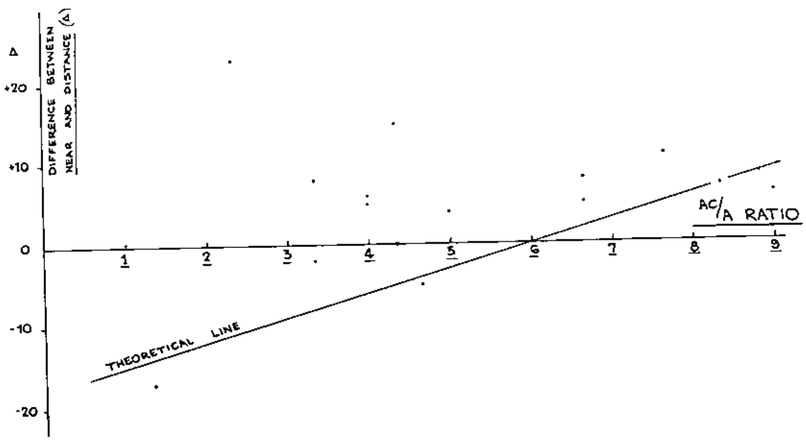

FIGURE 5 INTERMITTENT DEVIATIONS (15 CASES)

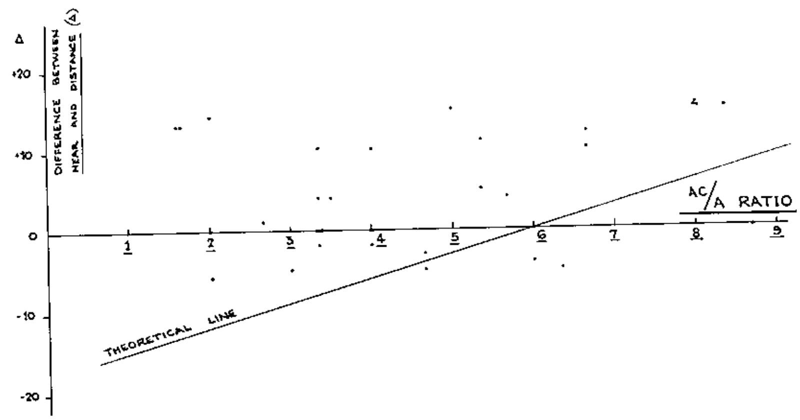

FIGURE 6 CONSTANT DEVIATIONS (33 CASES)

Discussion

This study has been centred around the theoretical AC/A ratio derived from an IPD of 6. It has been frequently noted in literature that the "normal" AC/A ratio is about 3.5[3]. But it must also be noted that about 80% of people who have a heterophoria, have an exophoria for near[4]. This would account for the moderately low AC/A ratio of 3.5 (in comparison to the ideal AC/A ratio of 6) as being the average, and thus being called the normal.

It is interesting to note that 36% of the sample in Figure 1 fell within an AC/A ratio of 3 to 5 and with a difference in measurements of +10Δ (i.e. 20Δ range). This suggests that an AC/A ratio of 3 to 5, although being expressed as the normal, is not really the ideal ratio to have.

Duke Elder[4] states that the AC/A ratio "applies only to patients with binocular single vision when used in its true sense", (e.g. in latent and intermittent deviations) "even in its absence, however, as in a manifest squint, it is of value to assess any anomaly of the ratio which may have determined the deviation".

However, the figures presented suggested that for esophoric, intermittent and constant squint patients there appears to be no correlation between the AC/A ratio and the difference between near and distance fixation measurements. In exophoric patients and for all cases combined (Figure 1), only an indefinite general trend to a positive correlation exists. However, in Figure 4, we see that orthophoric patients (i.e. basic deviation obtained from prism cover test done at 6 metres) did fall close to the theoretical line which then agrees with Duke Elder's statement.

The observation that, in Figure 1 the patient distribution appears to be higher than the theoretical line rather than centred around it is probably due to the fact that the theoretical line does not take into account the patient's proximal convergence, which would tend to increase the near deviation.

CONCLUSION

From the above findings the AC/A ratio does not appear to present as an accurate predictor of near deviation measurement compared with distance deviation measurement. The findings also contradict Bredmeyer and Bullock's statement[5] that, "regardless of whether a phoria or a tropia is present, the AC/A ratio is a primary factor responsible for the difference in the angle of deviation during distance and near fixation". It appears that the only occasion when one can predict the near deviation from the AC/A ratio is when the patient is orthophoric for distance fixation (i.e. 6 metres). But for heterophorias (for near and distance), intermittent or manifest squints it appears to be of value only to assess any anomaly of the ratio as a factor which may have determined the deviation.

Acknowledgements

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REFERENCES

1. LYLE, T. KEITH and WYBAR, KENNETH C. "Lyle and Jackson's Practical Orthoptics in the Treatment of Squint" 5th Ed. H.K. Lewis and Co Ltd, London, 1970, p. 298
2. BÜRIAN, M. HERMANN and von NOORDEN, GUNTER K. "Binocular Vision and Ocular Motility – Theory and Management of Strabismus". C.V. Mosby, St. Louis, 1974, p. 92
3. DUKE-ELDER, SIR STEWART. "System of Ophthalmology" Vol. VI Ocular Motility and Strabismus. Henry Kimpton, London, 1973. p. 208
4. Ibid, p. 200
5. BREDMEYER, HANS G. and BULLOCK, KATHLEEN. "Orthoptics, Theory and Practice". C.V. Mosby, St. Louis, 1968, p. 194

VISUAL ASSESSMENT OF CEREBRO-VASCULAR ACCIDENT PATIENTS IN REHABILITATION PROGRAMMES

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Abstract
The orthoptist's contribution is important in the therapy team's assessment of cerebro-vascular accident patients in rehabilitation programmes.
Visual findings in a series of 316 C.V.A. patients, are discussed.
Therapists show how these findings influence the interpretation of their tests and choice of treatment.

Key words
Cerebro-vascular accident, visual acuity, visual fields, rehabilitation.

The aim in assessing the visual functions in cerebro-vacular accident (C.V.A.) patients is not just to provide a visual acuity reading but also to evaluate the following:–

1) detection of visual field loss,
2) full assessment of ocular movements and muscle balance,
3) assessment of abnormal head posture which may be in the interests of binocular single vision,
4) assessment of stereoscopic vision, and
5) assessment of colour vision.

Knowledge of the state of the patient's visual capacity and resultant feedback is necessary before there can be accurate evaluation and subsequent treatment of sensory and motor disorders.

Ayres states the "execution of an adaptive response is dependent upon continual sensory feedback and adequate integration and interpretation of those sensations."[1] There is convergence of multi-sensory stimuli; these can be visual, auditory, olfactory, somesthetic and vestibular.

Birren states that "visual perception refers to these processes required to sense, interpret and respond to visual information"[2].

Studies with human beings demonstrate the dependence on feedback to perform accurate skilled motor functions. In a study by Smith, Ansell, Sherman and Smith, it was stated that "delaying the visual feedback in neurologically normal individuals resulted in severe disruption of learning and motor performance"[3].

The following are the trends that emerged from the examination of 316 C.V.A. patients at Lidcombe Hospital.

These C.V.A. patients are not a random sample. Patients with very mild C.V.A.'s who recovered spontaneously and those with extremely severe C.V.A.'s who were transferred to nursing homes were not often referred for assessment. Therefore the severity of the C.V.A. in this sample of patients varied between these two limits.

The sample was almost equally divided between males and females. (159 were males and 157 were females).

65% were tested within three months of the C.V.A. Because of this, the site of lesion was frequently unknown as CAT scans or brain scans had not been performed. Where the site of lesion was known, 59% were middle cerebral, 5% were posterior cerebral, 3% were from carotid insufficiency, 12% were vertebro-basilar and 21% were from other lesions.

Five of the basic motor and sensory problems found with C.V.A. patients were:– 1) Hemiplegia, 2) Neglect, 3) Apraxia, 4) Dysarthria and 5) Aphasia.

1) HEMIPLEGIA: "Is a weakness or paralysis affecting one side of the body, most commonly

caused by vascular lesion, tumour or trauma of the contra-lateral hemisphere".

2. NEGLECT: "Disorder ranging from a passive to an active neglect of personal or extra-personal space on the affected side due to the malfunction in the central processing system of the non-dominant parietal lobe.
3) APRAXIA: "The inability to motor plan although the means to execute motion is intact.
   a) Ideomotor Apraxia; May be able to execute the motion automatically, yet not in command.
   b) Ideational Apraxia; Limits the patient further and is unable to execute the act even automatically.
   c) Constructional Apraxia; Is in the inability to copy, draw or construct designs in either 2 or 3 dimensions and thus limits the patient's ability to manipulate his environment effectively.
4) DYSARTHRIA; "Term for a collection of motor speech disorders due to impairment originating in the central or peripheral nervous system. It affects respiration, articulation, ability to use voice and ability to maintain rhythm of speech.
5) APHASIA: "Communication disorder caused by brain damage and characterised by complete or partial impairment of language comprehension, formulation and use; It excludes disorders associated with primary sensory defects, genral mental deterioration, or psychiatric disorders. Partial impairment is often referred to as dysphasia"[4].

49% of patients had communication problems i.e. aphasia, dysarthria, deafness or dementia etc.

The average age of the patients was 67.0 years and as stated in a study by Dr. S. Sarks[5], this would put most patients into an age group having a higher incidence of cataracts, glaucoma, senile macular degeneration and refractive error. Any of these conditions may have the effect of reducing visual acuity.

The Anderson and Palmore survey[6] (1974) found that the proportion of people having V.A"s of 6/6 or better was 56% at age 60; and 14% at age 80. This shows a marked reduction in visual acuity in this age group.

In a survey of a random sample of people over 65 and using a standard of 6/12 (English driving licence standard) and N8, (the smallest print likely to be read) as a base, McWilliam found that only 14% of people did not reach this standard. He states that "with hindsight it would have been better to have chosen stricter standards"[7]. Using the same standards, (6/12 and N8) in the present study it was found that 14% of the patients had 6/18 or worse and 10% had N10 or worse. 4% were common to both groups i.e. had reduced vision for both near and distance. Therefore this is a total of 20% with acuity problems.

The number of patients with glasses totalled 91%, 42% had bifocals, 29% had readers, 4% had distance glasses only, 12% had both readers and distance glasses, 3% had some other form of glasses (e.g. frosted lens or prisms) and in 1% the intended usage of the glasses was unknown.

With aphakic correction the patient copes better when the object of regard is placed directly in front of him, i.e. helping to eliminate the "jack in the box effect". With bifocals, the focal range of the lenses is limited and therefore not practical in all therapy situations.

The method of testing visual acuity in the majority of patients was with the linear Snellens chart. Those unable to use this method were assessed using the following techniques:—

1.	Sheridan Gardiner Single Letters	37%
2.	Sheridan Gardiner Linear	20%
3.	Catford Oliver Drum	24%
4.	Snellen's single letters	11%
5.	With Numerals	4%
6.	Total unassessable	4%

Catford and Oliver[8] state that their test is to be performed at 60 centimetres; however, with the presbyopic patient, the test must be performed within the approximate focal range of the patient's near correction. By a simple mathematical process, the approximate visual acuity can be calculated. Using Snellen's principle, a 6/12 target seen at 3 metres is equivalent to a 6/24 target seen at 6 metres. Therefore with Catford a reduced 6/6 equivalent target is equal to a reduced 6/12 if the test is performed at 30 centimetres instead of 60 centimetres, i.e. at half the recommended distance.

The group with unassessable acuity was surprisingly small considering that many patients fatigued extremely easily or were so affected by receptive aphasia that even simple commands were not understood.

Quite a few patients complained that their glasses were unsatisfactory or that they were unable to read yet they had N5 vision, normal ocular muscle balance, Titmus better than 4/9 circles, convergence closer than 5 centimetres and no field loss. Thus the therapist, aware of no obvious ocular abnormality, could devise treatment appropriately.

The incidence of manifest strabismus in this study was 17% with 60% having latent deviations. The incidence of manifest strabismus in the normal population would be much less than this, however, the higher incidence of strabismus in this study may be related to the incidence of patients with markedly impaired acuity in one eye.

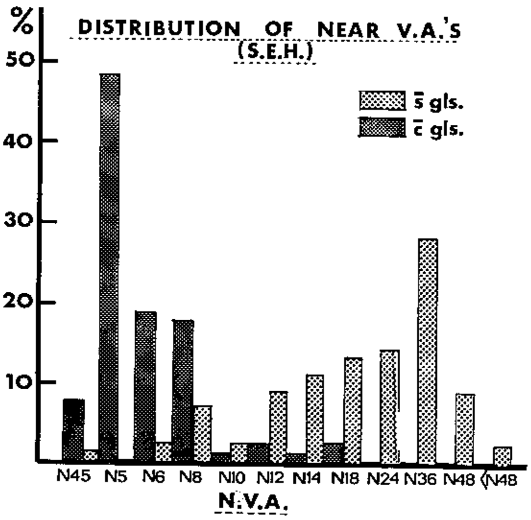
A sample of patients of the same age presenting at Sydney Eye Hospital Casualty Department was studied. The aims were:—

a) To compare the near visual acuity (N.V.A.) with glasses to that without glasses.

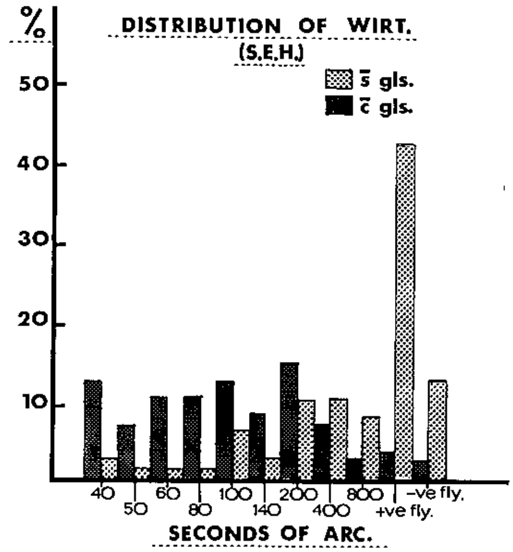
b) To compare the performance of Titmus Stereo-acuity test with glasses to the performance of the same test without glasses.

In 97% of cases, near visual acuity with glasses was better than without (see Graph I). In 87% of cases stereo-acuity was better with glasses than without (see Graph II). The maximal near visual acuity reduction was N5 to less than N48 and the maximal reduction of stereo-acuity was from 60 seconds of arc to zero appreciation. Whereas 92% could read N10 or better with glasses, only 15% could do so without glasses.

GRAPH I



GRAPH II



It is essential to understand this relationship as it stresses the importance of the correct use of glasses by the patient for fine motor tasks, remembering that 84% of patients have near correction.

21% of the total group or 29% of those accurately assessable have noticeable visual field defects. It should be noted that in many patients with dramatic aphasic and apraxic problems the site of the lesion is in an area involving the optic radiations. Hence one would expect that if the visual fields of every patient could be accurately assessed, the percentage with field loss would probably be higher.

Routine testing often gives indications that a field loss may be present, such as when the patient loses one side of the visual acuity chart, misses the first few words in near visual acuity testing, sees only one number of the two digit number as presented in the Ishihara colour test or seeing only one wing raised in the Wirt Titmus Fly Test.

The patient's subjective responses, (complaining of missing toast or dessert on their trays, etc;) may also give an indication of field loss. Sometimes the patients symptoms are wrongly attributed to other causes.

Case Histories

1. Mr. S.C. a 65 year old male was admitted with a second right C.V.A. with resultant left hemiplegia. His ocular complaints were that his "glasses were useless" and that he "had stopped reading". Because of the left homonymous hemianopia from his initial C.V.A., he had been referred to a low vision clinic where he was assessed as having R6/60 and L6/36 vision and subsequently prescribed a +8.00 dioptre sphere in the right eye and a frosted plano lens for the left eye, the +8.00 D.S. to be used as a magnifying device. Upon accurate assessment his corrected acuity was actually R6/6 and L6/9.

Obviously his hemianopic loss gave the effect of dramatically reduced visual acuity and he had been treated for such. The assessor did not realise the effect of the hemianopia on acuity assessment and/or it was not understood that hemianopic loss affects both eyes not just the left eye.

2. Mr. A. H. a 58 year old male presented with a left C.V.A. He also had a history of a superior temporal retinal vein occlusion in the left eye. His left visual acuity was counting fingers at one metre. His right visual acuity was 6/6, when tested by the Sheridan Gardiner method of matching letters. He had a marked right temporal field loss with little or no macular sparing. His C.V.A. had caused him to have alexia without agraphia, that is he could write letters or numbers but was unable to interpret them although he had written them himself. As Sorsby[9] states, most of these patients are initially diagnosed as having extremely poor visual acuity due to their inability to interpret what they see on the vision chart. His lesion was in the posterior parietal region separating his visual cortex on the right hemisphere from his speech areas in the left hemisphere in what is known as a posterior disconnection syndrome, so that the conventional methods of acuity testing would have given inaccurate readings.

CONCLUSION

In the future, more attempt must be made to stress the link between the visual needs of therapy and the visual capacity of the patients.

This could be done in part, by encouraging further inter-therapy liaison at a student level.

Therapists, on the whole are not often aware of the effects or management of general ocular conditions, (which may result in reduced acuity or field loss), or the difficulties that the use of aphakic lenses, bifocals or trifocals etc. may present.

The patient, their relatives and the medical personnel involved must be made aware that when dealing with homonymous field losses (i.e. Post chiasmal lesions), the defect is associated with both eyes and not just the eye on the patient's affected side.

Loughhead and Priest[10] related vision to everyday situations by reducing visual acuity by means of filters. Further studies of this type are needed, with tables relating tasks to varying degrees of visual impairment.

Much of that which applies to the assessment of C.V.A. patients, will apply equally well to patients with head injuries or neurological diseases needing assessment for rehabilitation.

Acknowledgement

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THE CONTRIBUTION OF VISUAL ASSESSMENT TO THE REMEDIAL THERAPIES

PHYSIOTHERAPY

The physiotherapist, concentrates on the physical rehabilitation of the stroke patient. The main aims are to retrain sensation of normal movement, balance reactions in various positions, symmetry, eye/hand co-ordination, normal posture reflexes, selective movement patterns, and concentration etc.

To retrain or treat a patient effectively, the physiotherapist should be aware of the part vision plays. Not only is it important to understand the visual deficits encountered by the hemiplegic patient, but also to note whether, prior to the stroke, the patient had some ocular condition or visual problems.

For example, if a patient has cataracts, it is important to know that he may have some impairment of vision, so that in his rehabilitation, it might be more appropriate to use verbal cues rather than visual ones.

If a patient needed bifocals previously, he may need to wear them during therapy. The therapist should be aware of the exact function of the particular glasses, so that therapy can be carried out effectively.

The hemiplegic patient may be left with several visual deficits resulting from the stroke. The therapists assessment of vision is only very basic and at times, inadequate, so the patient should be referred for full investigation and verification of their ocular deficits where this is possible. Once the problem is known the physiotherapist can plan treatment accordingly.

One of the most common visual disturbances is hemianopia. The patient with homonymous hemianopia can, in theory, be retrained to compensate successfully for his lack of vision by turning his head to the affected side, provided that there are no other intellectual and/or perceptual problems.

The furniture and the patient's position in the ward are so arranged as to facilitate and stimulate attention to the affected side.

The patient who experiences a disruption in binocular vision may have difficulties at certain distances. Therefore, one must try to work within his range or, perhaps on the orthoptist's advice, use some other adaption such as an eye patch so that treatment can be carried out effectively.

The patient who positions his head abnormally, may need to do so in the interest of maintaining binocular single vision or for the compensation of field loss. This means that body symmetry is disrupted. It creates difficulty with balance retraining, gait and normal everyday functions. Realizing that whilst the ocular problem persists the patients abnormal head posture must be maintained, it is necessary to have the visual problem rectified if possible, so that therapy can be more effective.

Therefore, visual information is important to the assessment and treatment of a patient. Only if the physiotherapist is aware of the visual deficits which a C.V.A. patient can face, will the retraining programmes be maximally effective.

R. La Spina B.Sc. (Grad. Dip. Phys.)

OCCUPATIONAL THERAPY

Visual assessment is an essential prerequisite for the O.T. assessment, in order to determine an accurate level of remaining function. The O.T. must be aware not only of visual disturbances associated with C.V.A.'s, but also those related to the ageing process.

This information is relevant to O.T. assessments of perception, function, appropriate retraining and also to apparent behavioural problems.

a) *Assessment of Perception* (The assessment of the patients remaining parietal lobe function, i.e. their ability to manipulate themselves and their environment for normal functioning, including body image, spatial awareness, visual agnosia, apraxia and neglect).

The following are some areas where our tests could be affected by visual disturbances.

1) With neglect it is essential to know if it is associated with hemianopia, as a patient with true neglect will not learn as readily to compensate, as does a patient with only an homonymous hemianopia.

2) Impairment of depth perception will affect results on some constructional apraxia tests, especially when done in three dimensions, e.g. block construction tests.

3) Hemianopia and/or reduced visual acuity will affect the layout and size of test material, e.g. in a formboard test, results could be misleading if material was placed in the area of the patient's field loss.

4) Diminished colour recognition will influence outcome on any test involving colour discrimination.

b) *Assessment of Function* (i.e. The evaluation of the patient's ability to perform selfcare, recreational and vocational tasks.)

Visual disturbances will affect recognition of and handling small items in:

1) Self-care skills e.g. buttons and zippers in dressing.

2) Domestic skills e.g. switches and dials on stoves and household equipment.

3) Work skills e.g. writing, reading and handling equipment.

Distance vision is necessary for some work skills and transport training, e.g. Reading bus numbers and the more advanced skill of driving.

The patient may present without problems in a well lit therapy room, but due to lens changes, may perform badly in poorer lighting. It is important to note this in home visits, as the lighting conditions in some homes can be appalling.

c) *Retraining:* The O.T. must know visual compensatory procedures as suggested by the orthoptist, e.g. Abnormal head postures, as this will influence the posture and positioning of the patient and materials and the distance and angle at which a patient can work at a given task.

d) *Behavioural manifestations:* Some of these can be attributed to a variety of untreated visual disturbances. This is especially relevent with suspected senile dementia and confusion. An obvious example was a patient labelled confused, due to her disorientation on the ward. On visual examination she was found to be partially blind.

Thus, occupational therapy assessment and retraining would be more significant if given specific visual information for each patient presenting with neurological deficit associated with cerebro-vascular accident.

B. Bates B.Sc. (Grad. Dip. O.T.)

SPEECH PATHOLOGY

The speech pathologist working with neurological impairment is involved in the assessment and management of 'language' impairment due to aphasia or to the disturbance of speech associated with the muscular weakness resulting from impairment to the cranial nerves associated withspeech. The respective terms "aphasia" and "dysarthria" have already been described.

For the purpose of this paper, 'language' is defined as the way we receive information (auditorily and visually), and produce it (by speech, gesture and writing) so that we can organise and interact effectively with our environment.

Both formal and informal test measures are used, which include:

a) Pictures of individual objects, a specific activity or series of activities which a patient may be requested to identify, name or describe.
b) Single words, sentences or paragraphs in varying sizes of print. Patient may be asked to read, re-phrase and/or answer questions about what he/she has read.
c) A set of common objects with which a patient has to carry out simple commands.
d) Figures for simple and complex calculations.

From these and other tests results, the speech pathologist will make decisions as to the patient's level of comprehension of auditory and written material and of his ability to organise and produce speech. It is therefore critical that the speech pathologist be aware of relevent information regarding the patient's visual status.

Similar principles apply to the therapy situation where a patient often has to work with "visually loaded" materials to compensate for his auditory deficits.

Retraining in dysarthria is also often dependent on relatively intact vision, as the patient may need to make use of diagrams, written material, visual display units, or follow a model produced by a therapist to monitor his speech behaviour.

A. Deane B. App. Sc.(Speech Therapy)

REFERENCES

1. AYRES, J. Sensory Intergration and Learning Disorders. Western Psychological Services. Los Angeles. 1973. 2:32
2. BIRREN, J. E. Handbook of The Psychology of Aging. Van Nostrand Reinhold Company. New York. 1977. 2:497-532
3. SMITH, K. U., ANSELL, SHERMAN and SMITH, W. M. "Sensory Feedback Analysis in Medical Research". Am. J. Phys. Med. 42, p.228-262. 1963. 42:228-262
4. From NICOLOSI, L., HARRYMAN, E. and KRESHEK, J. (1978) Terminology of Communication Disorders, Speech, Language and Hearing. Williams and Wilkins. 1978
5. SARKS, S. "Vision in the Elderly". Health Bulletin (EDB) 1978. 2:36
6. ANDERSON, B. and PALMORE, E. "Longitudinal evaluation of ocular function". In E. Palmore (Ed.) Normal Aging, Ed. Palmore E. Durham, North Carolina. 1974. 24-32. Duke Univ. Press
7. McWILLIAM, R. J. "Ophthalmological results of a geriatric assessment survey". Transactions of the Ophthal. Soc. of the U.K. 1975. 95:71-73
8. CA.FORD, G. V. and OLIVER, D. "A method of V.A. detection". Proceedings of the 2nd International Orthoptic Congress, Amsterdam; Excerpta Medica 1972 p. 183
9. SORSBY, A. Modern Ophthalmology. Butterworths. London. 1972. 3:362
10. LOUGHHEAD, J. and PRIEST, L. "An Evaluation of Visual Acuity Levels". 1979. Aust. Orth. J. Vol. 17

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1979-80, Vol. 17

THE SUBJECTIVE VISUAL ASSESSMENT OF THE SEVERELY MENTALLY HANDICAPPED CHILD

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Abstract
This paper describes an Orthoptist's role in the assessment of visual problems in the severely mentally handicapped child.
The tests employed and the findings of strabismus, nystagmus and visual acuity, are discussed. This work is the result of the examination of 385 patients.

Key words
Visual acuity, strabismus, nystagmus, mental retardation.

In this, the 'Year of the Child' it seems appropriate that attention should be given to a special group of children. Until quite recently, it has been customary for the majority of the populace to consider little, if anything, could be done to assist their problems. I refer to the severely mentally handicapped child. Over the last 5 years, I have worked with these children, at Marsden Hospital, Westmead, N.S.W., a unique residential environment that has care for 300 moderately and severely mentally retarded children, below the age of 16 years.

Marsden is fortunate to have an extremely comprehensive 'team' — comprising medical, nursing, psychological, social working, and educational members, plus occupational and physiotherapists, and an orthoptist. All areas interact with each other, and, as a great number of ocular problems are suspected, the eye clinic is kept fully occupied.

The 'eye team' at Marsden comprises an ophthalmologist, a general trained nursing sister and orthoptist, with referrals for assessment coming from any of the previously mentioned bodies.

Following the suggestion of the Ophthalmologist, the usual procedure at Marsden varies somewhat from other eye clinics, in that a "subjective" screening by the Orthoptist is carried out before the assessment by the Ophthalmologist.

Owing to behavioural, communication and physical disabilities evaluation of these patients presents problems in many aspects. The fact that the range of I.Q.'s is 38 and below, indicates that the majority of the patients have difficulty in understanding exactly what is required of them. Thus 'subjective visual assessment', as used in this paper, could be euphemistically defined as patient awareness and/or participation as opposed to objective assessment as described by Henry[1].

We try to assess these children using the basic routine tests of the orthoptic history card. However, obviously these children are unable to cope with many of the tests and therefore modification and limitations are necessary and achievements in this situation are explained below.

The patient is brought to the eye clinic by a nurse from the resident ward, i.e. by a person known to the child. This, we find, lends a sense of security to the child who is often extremely apprehensive of the situation. In the case of outpatients, a parent accompanies the child. A general trained nursing sister is always present in the clinic, and is of valued assistance with the behavioural and medical problems experienced by the patients.

Each child MUST be assessed individually and without interruption. Merely to gain the patient's confidence, co-operation and attention can take up to half an hour. Thus plenty of patience is an absolute necessity.

Investigation

The history is already provided in the patient's hospital file. The staff compiles an extensive comprehensive coverage of each child and any detail is recorded whether it be medical or social. Medication charts, which at times prove invaluable, are also available.

Symptoms are extremely rare and the parents and/or Marsden staff – doctors, teachers and nurses are the main source of supply in this area.

A wealth of knowledge is gained simply by observation: mannerisms, dexterity, facial asymmetry, general physical defects, abnormal head posture, strabismus, nystagmus, cosmesis, and visual alertness. Once sufficient trust has been gained and the patient's apprehension has abated, the testing procedure is commenced.

Tests

1. Cover Test is nearly always only carried out for near at a distance of 35 cms. as the child proves easily distracted from tests at 6m. A pen torch is always used and heavy reliance is placed initially on corneal reflections. Dissociation takes place when possible and fixation objects of varying sizes are utilized.
2. Ocular Movements are difficult to investigate, but many of the children will co-operate when encouraged and occasionally saccadic movements can be tested.
3. Convergence near point can be frequently tested. The only limitation being the questioning of diplopia on convergence break. Voluntary convergence is rarely performed.
4. Measurement of Angle of Deviation is achieved with prisms and this again is mostly at 35 cms., in the primary position. It is only the occasional child that has sufficient concentration to fixate at 6m. for the required time to take a measurement. The Hirschberg and Krimsky methods are used when possible. Prism Cover Testing is virtually unthinkable and/or extremely frustrating.
5. Pupillary Reaction is a test that is carried out, both directly and consensually, on every child. Despite the substantial drug dosages that many of the children are required to take, we have found surprisingly few pupillary reaction abnormalities.
6. Visual Acuity testing methods at Marsden are limited and the main instrument for measurement is the Catford visual acuity apparatus. However, it is possible with a few children to use Snellen's numbers and Fooks symbols, and five (5) patients have been able to read Snellen's letters.
7. It is interesting to read Seemin *et al*[2] on their findings of the Catford Apparatus, and I quote in part "that this technique is not a foolproof method" – with which I must agree. Yet, I question "what is". The same authors also state, and again I quote in part "that this optokinetic-nystagmus-like stimulus is a good qualitative test to determine the presence or absence of formed vision, but has limited utility in quantitating the degree of vision . . . and cannot be used to determine the exact level of vision". Be it so, but we have found the Catford drum a necessity with our work at Marsden and know of no other method that betters this apparatus at the present time. It is perhaps interesting to note that the very few patients on whom we have been able to compare the visual acuity on Catford drum and Snellen's number chart – show a discrepancy of one line – the chart giving the better acuity.
8. Catford & Oliver[3] in their series of testing with the drum used an oscillating speed of 1 cycle per second at 60 cms. This speed and distance were suitable for most of children at Marsden, but a few were only able to follow at a much reduced speed and the appropriate reduced distance.
   The drum is used mostly in the horizontal plane, but the vertical and oblique planes are employed when necessary, e.g. if horizontal nystagmus is present, or to check all the pathways of supra nuclear function.
9. Colour Testing is not often carried out, however, to know a few can cope with Guy's Colour Test, could be of interest to others working with mentally retarded people. The Ishihara Charts seem to be far too confusing for these children in our experience.
10. Visuscope examination is possible with a few patients. It is interesting to note that very few foveal reflexes are seen.
11. Prisms: the 4△ is not a satisfactory test with these patients – it is too small a movement to elicit an accurate response owing to their lack of concentration. 15△ elicits no response as the image disparity tends to be ignored – so a compromise is made and a 10△ is used where possible, and a few patients give a response, be it normal or abnormal.
12. Titmus Test is possible to carry out with a surprising number of the children. There are

always those that object strongly to the glasses, and those whose behaviour does not make the test possible. But in spite of the communication difficulties assessment of the test is made by observing the child's reaction when the Fly is presented. Occasionally the Animals are used and very few are able to give answers on the Circles.

13. Worths Lights. I always enjoy this test – never before has so much been seen by so few and a rainbow looks like a very small paintbox of colours by comparison! Needless to say, the spotlight using red and green goggles gives a better indication of visual function. By using this adaptation, it has been possible to gain accurate answers with some of the older and better children.

14. The Lang's Pen Location Test is rarely used, as communication and co-ordination problems are an enormous barrier. However, in some cases, this test has served to indicate binocular function.

Not all tests can be performed on every patient, they have only been listed as an indication of what has been found can be achieved with this level of mental retardation. There may well be other tests which I have not thought about, and any suggestions on the subject will be welcomed.

A synoptophore is not warranted with these children and any cases requiring further follow-up and testing are referred to outside orthoptists. Up to date there has only been 4 cases – 2 prior to surgery and 2 for attempted treatment.

Findings

Of all the facts and figures we have established in the eye clinic at Marsden Hospital, and as detailed in Henry's[1] paper, three (3) categories have been selected to examine in more detail from an Orthoptist's point of view.

Strabismus

Of the 385 patients seen 216 (56%) had squints of various types. This percentage is high when compared to the frequency of strabismus occurring in the normal population.

The classification of strabismus distribution is detailed in Table 1.

TABLE 1

STRABISMUS DISTRIBUTION OF 216 PATIENTS

Type of Squint	No Associated Factor	Accommodative Element (A)	Vertical Component (B)	A & B	Total
CONVERGENT:					
Intermittent	14	11		1	26 (12%)
Constant	57	20	17	3	97 (44.9%)
DIVERGENT:					
Intermittent	17		13		30 (13.9%)
Constant	32		25		57 (26.4%)
CONVERGENT/ DIVERGENT:	3		2		5 (2.3%)
VERTICAL:	1				1 (0.5%)
TOTAL:	126 (58.3%)	31 (14.4%)	56 (25.4%)	3 (1.9%)	216 = (100%)

It is interesting to note that a total number of 35 (16.2%) showed an accommodative influence. Accommodative element in this series is diagnosed only by observing an increase in angle with a more detailed fixation target, because more refined tests were not possible.

Of the remaining 167 patients, 107 (28%) had no manifest defect on cover test. This group includes heterophorias which by comparison were without problems.

62 (16%) of the patients were unable to be assessed either because of behavioural problems or they were seen only by the Ophthalmologist.

Nystagmus

A very high incidence of nystagmus revealed itself in this study – 96 cases (25%). This posed the question of how to present the findings. I have chosen to compare the nystagmus readings in relationship to the strabismus findings – other comparisons could be a subject for further study in the future.

TABLE 2

NYSTAGMUS

Strabismus	Horizontal	Torsional	Horizontal & Torsional	Horizontal End Pt.	Torsional End Pt.
I. HORIZONTAL					
1. CONVERGENT:					
Intermittent	1		1		
Constant	18	2	1	1	
Constant with Accom.	7				
2. DIVERGENT:					
Intermittent	1				
Constant	14	3	2	1	
II. HORIZONTAL WITH VERTICAL					
1. CONVERGENT:					
Intemittent	–	–	–	–	–
Constant	4		1	2	
2. DIVERGENT:					
Intermittent	1	1		1	
Constant	8	1	3	1	
III. CONVERGENT TO DIVERGENT WITH VERTICAL:	1	1			
IV. VERTICAL:	1				
V. NO SQUINT:	1	1	1	5	1
VI. NO COVER TEST POSSIBLE:	9				

These findings are detailed in Table 2.

In the category, no squint detected – total 9, there is an explanation for each case, except one.

- The horizontal nystagmus was progressive pathology.
- torsional nystagmus – a case of birth injury.
- horizontal & torsional nystagmus was a cerebral palsy child.
- Of the 5 children showing horizontal end point nystagmus, one was albinotic (a nystagmoid movement was evident only in strong light), one was hydrocephalic, one had Down's syndrome, and one had cerebral palsy. Pathology was unknown in one patient.
- Torsional nystagmus, present only in extreme dextro version, was seen in an epileptic child.

Visual Acuity

In this field of work it is more relevant to record the best functional visual acuity than to investigate the amblyopic readings. To know at what level a child can visually perform is of great value.

Maximum vision of 315 patients was recorded, and after compiling the figures and as detailed in Table 3, it was surprising to find that 158 patients (50.2%) had a reading of 6/9 or better.

Of these figures, 298 (94.6%) of the readings were recorded on the Catford visual acuity apparatus. These are the total readings of the best vision recorded in the following ways:–

TABLE 3

VISUAL ACUITY OF 315 PATIENTS

VISION	NUMBER OF PATIENTS	PERCENTAGE
Less than 6/60	21	6.7
6/60	7	2.2
6/36	11	3.5
6/24	16	5.1
6/18	37	11.7
6/12	65	20.6
6/9	104	33.0
6/6	49	15.6
6/5	5	1.6

BOTH EYES OPEN
MONOCULAR – i.e. True Alternators with equal V/A
R.E. only
L.E. only

The readings from the R.E. & L.E. results have further been analysed into four categories as to why it should be the eye giving the best vision.

These are:

Fixing Eye	–R.E.	22.8% or 72 patients
	L.E.	12.1% or 38 patients
Least Ametropic Eye	–R.E.	1.0% or 3 patients
	L.E.	1.9% or 6 patients
Other Anomalies	– R.E.	1.9% or 6 patients
	L.E.	1.9% or 6 patients
Causes Unknown	–R.E.	3.5% or 11 patients
	L.E.	2.6% or 8 patients

Discussion

Much has been written around the world of the ocular problems of the Cerebral Palsied Child, the Down's Syndrome and Rubella patient, and lately of Mentally Handicapped Children. All lead to the same conclusion that there is a high incidence of ocular anomalies and in many instances late recognition and analysis of the defects. Our findings at Marsden can only lend support to others.

For the severely Mentally Handicapped group, orthoptic treatment is not applicable. However, a reasonably comprehensive examination can be performed with patience and time.

Correction of significant refractive errors by spectacles has not proved to be a great problem with regard to acceptance – the teaching staff being of tremendous assistance in encouraging the wearing of the glasses in the school room, and with pleasing results in visual improvement. Lens occlusion has been carried out on six (6) children with improvement.

Cosmetic surgery has been performed on five (5) patients with mixed results.

The age of onset of squint has been impossible to determine in the past, but our range of patients now extends from three (3) months to 16 years, and with early intervention many secondary anomalies can be prevented.

All ocular information is recorded in the patient's history file, giving ready access to all other disciplines. The visual acuity is frequently of a high standard thereby permitting members of the other teams to relate their assistance and treatment to the patients' mental and physical capabilities.

Summary

In summary, it does seem that an Orthoptist plays an important role in the assessment of the Mentally Retarded Child, regardless of the severity of the handicap. Apart from his/her contribution to the complete ocular assessment which is regarded as direct assistance to the patient, i.e. to gain their best vision capabilities, indirectly he/she is contributing to the well being of the child by combining with other disciplines to ensure that his maximum potential is realised.

There is room for more Orthoptists in this work, and hopefully in the near future our numbers will be greatly increased.

Acknowledgements

There are many people to whom I must express my appreciation for their interest in this paper, but in particular, I wish to thank for their assistance, guidance and encouragement:–
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REFERENCES

1. HENRY, J. G. The Ophthalmological Assessment of the Severely Retarded Child. 11th Annual Scientific Congress R.A.C.O. 1979.
2. SEEMIN, G. Khan *et al.* Subjective & Objective Visual Acuity Testing Techniques. Arch. Ophthalmol. Dec. 1976, Vol. 94.
3. CATFORD, G. V. & OLIVER, A. A method of Visual Acuity Detection. Proceedings of the Second International Orthoptic Congress, Amsterdam. Excerpta Medica 1972, p. 183.

THE RESULTS OF VISUAL SCREENING OF 80 MENTALLY RETARDED CHILDREN

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Abstract
In 1977 and 1978, 80 mentally retarded children were visually screened by an orthoptist. The results showed a high incidence (28%) of strabismus and defective vision (66%).

Key words
Visual screening; mentally, physically handicapped; vision; strabismus.

In N.S.W., vision screening of mentally and physically handicapped children is the responsibility of the N.S.W. Health Commission's School Medical Service. Orthoptists have been employed in the difficult task of assessing handicapped children only in rare instances. In 1977 and 1978, the Orthoptic Department at Sydney Eye Hospital was approached and agreed to screen the children at Bates Drive and Sylvanvale Schools, which are in the southern suburbs of Sydney. Orthoptic help was sought because of the difficulty experienced by the School Medical Service sister when attempting to test these children.

The Bates Drive School is run by the N.S.W. Department of Education and the children range from 5-16 yrs. They are considered to be moderately retarded i.e. the I.Q. level is between 30-55. This school was first visited by an orthoptist in 1977, and each of the 50 children was cover tested and had their vision tested. In the following year a further 14 children were screened and additional tests were carried out. Thus 64 children, over 2 years were visually screened at Bates Drive.

In 1978 it was suggested that 26 children at Sylvanvale be tested also. This school is privately run by the Handicapped Children's Association. The children's ages range from 4-12yrs. They are considered to be severely retarded, so much so that none had been visually assessed before, as the task appeared impossible.

The causes of the retardation of the 80 children screened are shown in Table 1. (This information was taken from the school's records, which were not always complete, hence the large number of unstated aetiology.)

TABLE 1

Disability	Number
Down's Syndrome	28
Epileptic	2
Cerebral dysfunction	1
Microcephalic	1
Rubinsen Taybi Syndrome	1
Hurler's Syndrome	1
Viral encephalitis	1
Brain damaged	2
Unknown	43
TOTAL	80

The tests performed in 1977 were: vision with either the Sheridan Gardiner linear chart, or the Sheridan Gardiner single optotypes or the Catford Oliver Drum, and cover tests. In 1978 the list of tests was extended to include, ocular movements, the Titmus Stereo Test, colour tests with the Ishihara or Matsubaru tests, and 15△ prism test for fusion response. All the tests were performed at the school, but not under ideal conditions. The clinic room was not 6m. in length, and as the children could not cope with doing a vision test in a mirror, most of the testing was done in the workshop amid power drills and work benches.

At Sylvanvale the room was long enough to perform 6m. vision tests, but because of the gross retardation of this group of children it was more appropriate to use the Catford Oliver Drum in the majority of cases. Neither colour vision nor the Titmus Stereo Test could be performed by them.

Results

Visual acuity was assessed using the Sheridan Gardiner linear chart, Sheridan Gardiner single optotypes or the Catford Oliver Drum. The test chosen depended on the capacity of the child. Of the 80 children only 14 were non-assessable. The majority were able to manage the Sheridan Gardiner linear test.

TABLE 2

Type of Test	No. of children
Sheridan Gardiner linear chart	42
Sheridan Gardiner single optotypes	7
Catford Oliver Drum	17
Non-assessable	14

34% had equal vision of 6/9 or better in each eye.

Strabismus was detected in 28% of the children.

Nystagmus was noted in 4 children, and latent nystagmus in 3 children.

TABLE 3

Convergent strabismus	=13
Divergent strabismus	= 7
Vertical strabismus	= 2

No additional defects were found by performing an ocular movements test.

Colour vision was attempted on 21 children at Bates Drive. 5 of the 21 who attempted the test gave a positive result. The other 16 children could not perform the test. Without further investigation, it is not possible to decide whether these results indicate a high incidence of colour vision defects.

The Titmus Stereo Test was attempted on the same 21 children as performed the colour vision test. 15 children were able to perform the test, 6 showed appreciation of depth on the Fly test only, and the remaining 9 had stereo-acuity of better than 400 seconds of arc. It was felt that some of the children had such difficulty in understanding the test and so it is likely that the results give both false positives and false negatives.

In this group, tested by an orthoptist, there was found a high incidence of reduced vision and strabismus. Many authors Banks (1972, 1974)[1,2], Breakey (1955)[3], Douglas (1961)[4], Fantle and Perlstein (1961)[5], Gardiner (1967)[6], and Venables (1967)[7], have found higher incidence of ocular defects and no doubt with a thorough ophthalmological examination other ocular defects would be diagnosed and causes found for the large percentage with defective vision. It is argued that the treatment of ocular defects such as strabismus or refractive errors do not help in the rehabilitation of handicapped children, but Banks states "that the earlier and better the visual sense functions then the greater the child has of achieving his potential." He also states "that reassurance of parents that their child has normal vision and healthy eyes removed a great deal of worry, and sensible discussion and explanation about children with ocular abnormalities went a long way in helping parents to accept a mentally and visually handicapped child. Such advice and reassurance however can be given only when the developmentally handicapped child has received full ophthalmic and orthoptic examinations."

CONCLUSION

Vision screening is possible and can be accurate if the child is in quiet and familiar surroundings and has a sympathetic and patient examiner. Retesting of vision in particular, may be necessary to ensure that the child's possible poor vision is not simple his inability to perform the vision test. Accurate assessment of ocular motility is also possible if care and time is taken. Although the Titmus Stereo Test was attempted on only a small number of children, indications were that it is difficult for these children to comprehend this test and therefore a more accurate and easier test to administer is the 15△ prism placed base out to test for fusion. All children with good vision, without a strabismus and irrespective of mental ability, gave a positive response, even those who had failed on the Titmus Stereo Test. The percentage of defects found was less than that of Banks, but the reason may be because some children with known defects were not screened. But, it may also be because some defects do not show up on a screening test, which would indicate the need of a full ophthalmological examination for mentally and physically handicapped children.

REFERENCES

1. BANKS, J. L. K., THORNHILL, D. M., ROUSE, E. L., and CORR, P. E. (1972). Orthoptics, J. Mein, Amsterdam, Excerpta Medica. 1972, p. 333.
2. BANKS, J. L. K., "Eye Defects of Mentally Handicapped Children". Brit. Med. J. 1974, 2, p.533-535.
3. BREAKEY, A. S., "Ocular Findings in Cerebral Palsy". Archives of Ophth. 1955, p. 852.
4. DOUGLAS, A. A., Cerebral Palsy in Childhood and Adolescence. Ed. J. L. Henderson. Livingstone. Edinburgh. 1961, p. 19.
5. FANTLE, E. W., and PERLSTEIN, M. A., "Ocular Refractive Characteristics in Cerebral Palsy." Am. J. of Diseases of Children, 102, p. 36.
6. GARDINER, P. A. "Visual Defects in Cases of Down's Syndrome and in Other Mentally Handicapped Children." Brit. J. Ophth., 51, 1967, p. 469.
7. VENABLES, W. A., "The Incidence of Squint in Minimally Handicapped Children." Brit. Orthop. J. 24, 1967, p. 53.

BIBLIOGRAPHY

EDWARDS, W. C., PRICE, W. D., WEISSKOFF, B. "Ocular Findings in Developmentally Handicapped Children." J. Paed. Ophth. August, 1972, Vol. 9, No. 3, p.162-167.

HILES, D. A., HOYNE, S. H., McFARLANE, F., "Down's Syndrome and Strabismus." AM. Orthop. J. 1924, Vol. 24, p. 63-68.

LOWE, R. F. "The Eyes in Mongolism." Brit. J. Ophth. March, 1949, p.132-174.

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A STUDY OF VISUAL DEFECTS IN HEARING IMPAIRED CHILDREN

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Abstract
Findings from the visual screening of a group of 40 hearing-impaired children are presented. The incidence of visual defects is found to be higher than in the normal school age population. The reliance on vision for speech interpretation is emphasised and modifications of testing methods are described.

Key words
Deafness, visual screening, speech reading.

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

The aim of this paper is to call attention to the importance of good binocular vision for the integration of deaf children into a hearing society, and to discuss the methods and findings of visual screening carried out on two groups of these children.

Similar studies[1,2] have stressed the need for deaf children to be regularly assessed for visual disorders.

Deafness, like blindness, is in many cases not absolute. The vast majority of children have some usable hearing, although it may be very defective. The lowest sound level that can be heard by an individual is assessment of deafness. The softest sound a normal ear can appreciate has a level of zero decibels (I.S.O. standard). The mildly deaf can appreciate sound at 20-40 decibels, the moderately deaf at 60-80, and the profoundly deaf can hear sound only at the 80 decibel level or higher. A hearing aid amplifies sound, but does not restore normal hearing to its user.

For many people the image of a deaf person is of somebody who speaks with his hands. Current educational management of a young deaf child discourages the use of any sign language. He is encouraged to communicate by speechreading and the use of hearing aids, so that in time he may take his place among hearing companions.

Mrs Alexander Graham Bell in 1894 described speechreading as "essentially an intellectual exercise; the remedial part performed by the eye . . .". Speechreading is a combination of watching and reading the speaker's lips as well as listening for the amplified sounds which may be picked up though the hearing aids, the aim being to understand the spoken word and conversation.

The ability to speechread well probably depends on several factors, including

1. good visual acuity
2. good accommodation which can be maintained over long periods,
3. above average visual perception,
4. full visual fields, which enable the speechreader to gain in information from the face and setting whilst still focussing on the mouth of the speaker, and
5. good visual memory.

Programmes to teach oral communication to deaf children follow a pattern of auditory training, cognition, speech training, all of which are combined in a single lesson. Several such lessons are given every day. The main stimulus is provided by visual input, combined with tactile stimulation and residual hearing.

Some deaf children are multi-handicapped. This is especially likely when the cause of deafness was rubella, which causes eye defects as well as hearing defects. It is for this reason that deaf children are now being screened more widely for eye problems. Early detection and treatment of ocular defects allows the child the advantage of the best possible sight.

The 40 deaf children with whom this paper is concerned were from the Shepherd Centre for Deaf Children, Sydney University, and from the Opportunity Deaf Class at Granville primary school, the latter group attending as part of the school screening system.

The children ranged in ages from five months to fourteen years. The degree of deafness ranged from a mild loss to profoundly deaf. As many as possible were given a full orthoptic assessment.

Generally speaking, it is just as easy or difficult to test a deaf child as a hearing child. It is important to talk just as much, if not more, to a deaf child than to a hearing child, repeating whole phrases, not just words. State first what you want him to do, and then show him. To show first, or while you are talking, will only attract the child's attention away from your face so that he misses what you are saying.

Visual acuity was usually tested first. If performed well it gave confidence to both the child and the orthoptist. As part of their schooling, from as young as eighteen months to two years, the children match animals, progressing to letters and words, and therefore the Sheridan Gardiner test was readily understood. It is often best to start close to the child where he can gain information from your lips and face, encouraging him when he perform correctly, and then to move back to the appropriate distance. It is better not to point to the letter or picture, but to encircle it with your finger as this reinforces the method taught at school.

6 of the children were found to have defective vision.
2 had strabismic amblyopia
2 had refractive or anisometropic amblyopia
1 showed signs of retinopathy, and
1 case was of unknown cause.

Ocular motility was assessed by cover test, ocular movements, and convergence. Most of the children willingly looked at an accommodative target long enough for an accurate cover test to be performed.

5 children would not allow either eye to be covered; by cornela reflections their eyes appeared straight. Of the remaining 35
13 were orthophoric
7 were esophoric
3 had constant convergent squint
8 were exophoric
3 had intermittent divergent squint, and
1 had a constant hypertropia

Ocular movements were performed using a visual stimulus; surprisingly, squeaky toys proved successful as some children were able to hear them. Older children performed well when asked to follow a light.
4 children were unassessable,
29 had no apparent muscle anomaly
5 showed underaction of a superior oblique muscle
1 had Brown's syndrome, and
1 had a lateral rectus palsy

Convergence was assessed using a fixtion target, not the R.A.F. rule.
4 children were not tested for various reasons.
30 had full convergence,
6 had a near point further than 5 cm.

Binocular single vision was tested using the Titmus and in some cases the TNO stereo acuity test. These proved to be much more easily done than one would have expected. The children readily pointed to the correct item with little or no encouragement. Good stereoacuity was demonstrated in most of the children tested. The Ishihara colour vision test gave no trouble with the older children, who traced the numbers wihtout prompting. No case of defective colour vision was found.

In this survey the testing of visual fields was not attempted, possibly because of difficulties due to age and deafness, but I feel that this is an area which should be investigated, as these children rely heavily on peripheral vision to gain information about the conversation and surroundings whilst speechreading.

Many of the children, especially of those from Granville school, had not been refracted. Of the 5 patients with known refractive errors, 4 were myopic, and 1 hypermetropic, 3 of the group having anisometropia. These five constituted 12.5% of the total. Previous studies[1,2] of the refractive errors in deaf children found approximately 38% requiring a hypermetropic correction while about 9% were myopic. Using the basic procedures of our survey, hypermetropia would not be detected.

It was noted from the medical records that for twenty two children the cause of deafness was unknown. Ten cases were due to rubella. Five of these ten children had retinopathy, consisting of retinal pigmentation and paramacular pigmentary stippling. The pigmentary disturbances did not appear to interfere with visual acuity.

It should be remembered that deaf children with severe eye pathology and blindness would be in schools or institutions for the severely and multi-handicapped. The children whose assessment has been described in this paper have the major handicap of deafness, and are being screened for associated eye defects.

CONCLUSIONS

Forty deaf children were screened for visual disorders. Apart from the incidence of refractive errors, the findings agree well with previous studies. Six of the children were found to have ocular defects.

Several facts became apparent during this study.

1. All deaf children, where possible, should be screened for eye defects. This study confirms that of others, that there is a higher incidence of eye problems in these children than among normal hearing children of their age.
2. Visual input is the prime stimulus that these children rely on to gain information from speech and their environment. Treatment of any visual disorder, especially refractive error and amblyopia is of the utmost importance. In addition, it must be remembered that the children already have a severe handicap which is receiving intense treatment; our treatment should be carefully adapted so as to assist, and never to hinder, their progress.
3. Testing procedure may be modified within reasonable limits, but these children are generally not lacking in intelligence. One explains testing procedure to them as one would to any child of the same age.

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REFERENCES

1. DAYTON, KARLA K. "Oculomotor and Visual Problems in Deaf Children". American Orthoptic Journal Vol. 20, 75-81, 1970.
2. STOCKWELL, Eunice. "Visual Defects In The Deaf Child". Archives of Ophthalmology, Vol. 48, 428-432, 1952.
3. BELL, ALEXANDER GRAHAM. Association For Deaf. Inc. Second Edition.

THE ORTHOPTIST'S ROLE IN REHABILITATION OF THE PARTIALLY SIGHTED

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Abstract
The Orthoptist's role in the Rehabilitation of the partially sighted, at the Royal Blind Society of New South Wales is in the Children's Development Unit, the Sensory Development programme and the Low Vision Clinic, with a specialised Vision Training Programme.

Key words
Rehabilitation, partially sighted, Children's Development Unit, sensory development, vision training, Low Vision Clinic.

During 1979, an Orthoptist has been working in three major fields at the Royal Blind Society of New South Wales. These are in –

The Children's Development Unit, to which an Orthoptist has continued to be seconded from Sydney Eye Hospital.

The Sensory Development Programme, which is designed to assist clients who have recently become blind to make the best use of their other senses.

The Low Vision Clinic, to assist patients to make the best use of their low vision aids and to provide a most exciting Vision Training Programme for patients with macular degeneration.

1. Children's Development Unit

This unit has been previously described by Pardy & Guy[1]. This service has proved extremely beneficial in assessing the amount of residual vision of the pre-school clients. This assists in the structuring of the most suitable education programme for each child.

It has been proved that partially sighted children benefit most from being educated with normally sighted children, if this is possible, at the playgroup, pre-school and school stages. The staff of Children's Development Unit (including the orthoptist) is directly responsible to the Honorary Medical Advisory Panel which consists of several Ophthalmologists, Paediatricians, Psychologists, and an Orthoptist, all of whom plan the most suitable training programme for the child and his family.

If a child cannot manage in a normally sighted learning situation, he may attend the Department of Education North Rocks Central School for Blind Children or the new special school for multi-handicapped children also at North Rocks, or St. Lucy's School for Blind Girls or St. Edmund's School for Boys.

This service is continuing with an Orthoptist seconded from Sydney Eye Hospital (because there are insufficient funds available at present), and the Royal Blind Society is very grateful to Shayne Brown and her staff for continuing to provide this service.

2. Sensory Development Programme

This is the second role of the Orthoptist at the Royal Blind Society, and it is in a programme designed for clients who have recently become blind to make full use of their other senses and thus help them to regain some independence. The aim is to re-direct sensory awareness away from sight and on to other senses, principally hearing and touch, and to learn that these other senses can be a reliable source of acurate information about the environment.

I shall quote a paragraph from a paper written by Sue Thomas[2], the Occupational Therapist in charge of the programme.

"The first session is introductory. With the help of an Orthoptist, each person explains his visual problem. This is very helpful for me and also helps members understand each other's conditions and the fact that there are many types of impairment. At this time clients are able to ask questions regarding glasses and surgery and, having dealt with these, are more willing to move on to the other senses. We stress the usefulness of remaining vision but explain that, for the purposes of this course, exercises are done with eyes closed to aid concentration.

It is important to note that when we refer to a patient as being blind, we can and often do mean that they are partially sighted, as many 'blind' people have some residual vision.

Following this programme, most patients are then trained in areas of orientation and mobility, activities of daily living, and communications and manual skills, all offered by the Society and tailored to the patients' needs.

The clients who have completed this programme have all shown a marked improvement in confidence and have all performed very well in learning other new skills, once they have become aware of their other senses. Some patients have then participated in the Vision Training Programme as a direct result of their residual vision being observed in this group situation.

3. *Low Vision Clinic*

This is the third area of participation for the orthoptist and at present is the most challenging. The patients are examined by the Ophthalmologist and low vision aids in the form of magnifiers and telescopes are prescribed, if necessary. Most of the patients need careful instruction in the use of these aids, along with advice as to adequate lighting for each aid. Many of these patients are assisted by the orientation and mobility instructors in the use of these aids, in consultation with the Orthoptist.

The most recent and exciting breakthrough has been in the VISION TRAINING PROGRAMME. This programme was first described by Professors Otto and Bangerter in St. Gall, Switzerland and published in 1971, in which they describe the retraining of patients with macular degeneration to use a paramacular point as their primary point of fixation.

This treatment has been adopted and is now giving some very promising results with patients referred to the Low Vision Clinic. Once the eccentric point of fixation which gives the best visual acuity has been established the patients are encouraged to use this point during everyday tasks with weekly re-inforcement and encouragement by the orthoptist, with special emphasis on the visual angle and visual direction of the eccentric point. After prolonged stimulation, the patients use this point of fixation all the time and it becomes a conditioned reflex with other functioning points of the retina become orientated to it.

It is very important for these patients to realise that we cannot give them the vision they have lost but only reinforce what is left. To date 27 patients have participated in this programme, 3 were rejected after the initial visit as they had central fixation and thus the visual acuity could not be improved. Of the 24 remaining, most have senile macular degeneration, 2 have optic atrophy, 2 have pseudo-xanthoma elasticum and one had problems as a result of rubella. 15 of these had 2/36 or worse visual acuity and now have 2/12 or better, whilst 8 of the others have improved at least by 2 Snellen lines. Two of the patients have actually improved from counting fingers to 2/6 and 2/4.

Not only is this marked improvement in measurable visual acuity most rewarding but the patients' improvement in mobility is astounding. In all cases the patients have remarked on their regained independence, at least with some tasks, such as shopping and cooking. Most patients can now watch television comfortably and many can read N.5 (7 patients), some with the use of magnifying aids and some without.

Case History:

1. M.W., 57 years. Senior executive, department of education. Presented with 2/36 visual acuity in his best eye, with pseudo-xanthoma elasticum, faced with early retirement and having to relinquish his position. After one week of practising the techniques explained to him, visual acuity was 2/5 and N.10 unaided. Mr. W. is now a very relaxed, competent executive who can now read typewritten copy, and thus communicate in board meetings without embarrassment and looks forward to a happy and rewarding retirement on completion of his challenging career.
2. C.L., 79 years. Senile macular degeneration. First visit – counting fingers. Hand Movements. Now 2/6 and N.5 with aid, can watch television, read the Herald each day and look after herself; formerly she had to rely on her daughters even to make her a cup of tea.

This programme has given all the patients a new lease of life. They can re-commence their hobbies and interests and look after themselves without having to rely on relatives and friends. The patients most suited to this programme are older patients with macular degeneration who still have the desire to be as independent as possible.

Acknowledgement

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This paper was preceded by a film entitled "Future Sight" which is available form the Royal Blind Society of N.S.W.

REFERENCES

1. PARDY & GUY. "The Orthoptists role in a team approach to Visually Handicapped Children". Australian Orthoptic Journal. 1978. Vol. 16.
2. THOMAS, S. "Sensory Development for Visually-Impaired Adults". Rehabilitation in Australia. April 1979. Page 37.
3. OTTO, J. "Etablissment du diagnostic et reeducation des personnes atteintes de graves lesions organiques de la vision."

BIBLIOGRAPHY

BARRAGA. N. "Increased Visual Behaviour in Low Vision Children". New York, American Foundation for the Blind, 1964.

FAYE, E. "Clinical Low Vision (1976)." Little Brown and Co. Boston.

GOODRICH, G.L. and QUILLMAN, R. D. "Training Eccentric Viewing" Visual Impairment and Blindness. Nov. 1977. p. 377.

HOLCOMB, J. G. and GOODRICH, G. L. "Eccentric Viewing Training" Journal of the American Optometrical Association. Vol. 47. No. 11. Nov. 1976. p. 1438.

MOORE, M. W. "Visual Efficiency Training with Low Vision Children". American Orthoptic Journal. Vol. 22. 1972. p. 68.

SHANG, M. "How are young blind children catered for in Australia". Insight Vol. 18. No. 4. Sept 1979.

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AN EVALUATION OF VISUAL ACUITY LEVELS

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Abstract

The aim of this paper is to demonstrate how a person with a visual acuity deficit can function in day to day living. This was achieved by using graded filters to simulate visual acuity levels ranging from 6/6 — 1/60. Then with each visual level, activities involved in daily living were performed. The results are summarised in table form and some experiences have been related.

We concluded, that although a person may be classified as 'blind', in most cases, there is some residual vision which may be used to improve the individual's independance and enjoyment of life.

Key words

Simulated reduced vision, activities of daily living, residual vision.

Introduction

In the past many people suffering from a visual impairment have been treated as though totally blind, although many retain some residual visual ability. This concept has recently come under criticism.[1-2-3] The majority of 'lay' people still believe that a person classified as blind lives in a world of darkness totally devoid of light stimulation. However we know this is not always the case.

Aim

The aim of this paper is to demonstrate how a person with a visual acuity deficit can function in the process of day to day living and in particular to emphasise the difficulties and potentially dangerous situations they may encounter. We feel there exists a need to emphasise the statement that residual vision is useable vision and thus should be exploited whenever possible to give the patient every opportunity to lead as visually normal a life as is possible.

This information may be relevant and of value to other therapists, by making them aware of the extent to which they can exploit their patients visual ability, no matter how minimal it may be, to improve their self reliance.

At the present time qualification for a blind pension is restricted to those individuals who have a visual acuity of 6/60 or less in the better eye, or having a visual field defect e.g. tunnel vision[4]. However it is only necessary to have a visual acuity of 6/24 or less in the better eye to be eligible to attend a school for the visually impaired.

One must remember, of course, that 6/12 vision does not represent an effective visual function of only 50%. The following table compares visual acuity levels with effective loss of visual function.

TABLE 1
Relation between Visual Acuity Notations and Percent of Macular Visual Efficiency

SNELLEN'S FEET	NOTATION METRES	VISUAL ANGLES IN MINUTES	VISUAL EFFICIENCY IN MINUTES	PERCENTAGE VISUAL LOSS
20/20	6/6	1	100%	0.0%
20/25	6/7.5	1.25	95.6%	4.4%
20/30	6/9	1.50	91.4%	8.6%
20/40	6/12	2	83.6%	16.4%
20/60	6/18	3	69.9%	30.1%
20/80	6/24	4	58.5%	41.5%
20/120	6/36	6	40.9%	59.1%
20/200	6/60	10	20.0%	80.0%
20/400	3/60	20	3.3%	96.7%
20/800	1/40	40	0.1%	99.9%

Method

A) Blurring Visual Acuity

1. A standard Snellens linear test type chart was placed at six metres and our visual acuity recorded uniocularly. We classified ourselves as the normal as we each have a visual acuity of 6/6 or better in both eyes at both near and distance testing.
2. In each case we totally occluded our non dominant eye with an opticlude face patch thus excluding all visual information to that eye.
3. Using the series of graded occluders we placed these directly before the dominant eye, using the vision chart and increasing the density of the occluder until the required visual acuity level was obtained, ranging from 6/9 to 6/60. We were unable to obtain a satisfactory blur using the graded occlusion for visual acuity levels 3/60 and 1/60, so we employed commercially available 'contact' on plano glasses.
4. We then secured the graded occluders before the dominant eye using adhesive tape in a similar fashion to face occlusion.
5. Various activities were then performed both inside and outside the home environment. The activities were chosen as we felt they were involved in day to day living, for example, watching television requires visual appreciation as well as auditory information. Each activity was performed with each visual acuity level and the ease or difficulty recorded.

Obviously, artificially blurred vision will not accurately convey the effect of one with a pathological defect; quite obviously a visual field defect will be totally different. Furthermore, one may argue that a strabismic amblyope will receive a vastly different visual impression than a person suffering from macular degeneration. As normal visual acuity is usually found in the non squinting eye it would seem that in undertaking occlusion therapy this patient will be better able to cope. Our experience revealed that due to our previous knowledge of shape, size and colour of objects we were better equipped with a vast visual memory which increased our chances of correctly identifying an object or aided our performance of a manual task. On the other hand, one could argue that a person who has had a visual impairment from birth or an early age may be better adapted as they have developed greater sensitivity of their other senses, particularly touch, which may more than adequately compensate for their lack of visual perception.

Secondly, as one eye was totally occluded we were placed in an abnormal situation with the absence of stereoscopic clues to depth. This may have hindered our judgement of distance. Negotiating stairs was particularly difficult as was boarding and alighting from public transport.

We have attempted to examine the problems in a chronological sequence to represent the activities involved in an average day.

Grooming

In most cases, even with 1/60 vision at close range we could distinguish labels, seams and hems to tell whether the clothes we were about to put on were inside out or not. Otherwise it was necessary to use tactile information.

When applying make-up it was much easier to use bright colours such as iridescent green rather than more subtle colours and skin tonings. Caution was needed when using mascara, eyeliner and eyelash curlers, especially concerning the lower lids as they simply couldn't be seen. We tended to cake on the blusher so it was visible and we finished up with lipstick all over our mouths and teeth. Now we know why one often sees little old ladies in the street looking as though they had just walked out of a clown circus act – they probably have cataracts or macular degeneration. Therefore, magnifying mirrors should assist these people. Both men and women should be cautious when shaving with impaired vision, taking care with moles, rashes, blemishes, etc. It was realised that one can part one's hair with any vision but unless one had 6/18 vision or better one can't tell whether the parting is straight or crooked.

Home Duties

Most of these experiences are related to VA 6/60 and less. When preparing food it was impossible in most cases to tell visually whether the food was good or bad (worm holes in apples, mould on bread). However, sometimes one can rely on smell (sour milk) and if all else fails one can always taste it!

One must always be careful with any visual level less than normal when eating fish as it is impossible to see the bones, instead it was necessary to feel with one's fingers. Therefore, never go to a restaurant with your friends and order fish – they won't be your friends for much longer.

To identify the required food in the fridge one must almost be sitting on the shelf beside the food before this is possible. When cooking food in a saucepan of water, e.g. rice, the only way to tell whether it was boiling dry was to put one's face into the saucepan and risk getting scalded by the steam, or wait until there is a burning smell. This may be overcome by periodically filling the saucepan with small amounts of water.

When using scales and measures it would be easier to use those with raised numerals, making use of tactile as well as residual visual information.

When pouring cold liquids one can rely on placing one's finger at the required level. However, when pouring hot liquids one must rely on the amount and time that one has to tip one's hand, from previous experience.

When washing up one relies almost solely on the sense of touch, i.e. feeling for loose food particles, therefore one can't wear rubber gloves and will develop dishpan hands. It is probably easier to buy a dishwasher.

As for vaccuuming, sweeping and dusting with less than 6/18 VA one is unable to see any dust or dirt even at close range. Therefore, the most sensible thing would be to carry out these tasks regularly, regardless.

It was relatively easy to identify a required key on a small bunch of variable shaped and sized keys but with decreasing vision it became markedly harder to fit the key in the lock.

Transport and Mobility

With less than 6/60 vision one of the biggest difficulties just walking down the street, apart from the lack of depth clues, was the lack of appreciation of contours of the footpath and road surfaces. For example, holes, stones, twigs, leaves, a step from the footpath to the road, and dog's messages. Often, inclined surfaces were difficult to differentiate from flat surfaces and one relied more on postural and proprioceptive clues. Walking up a hill, one's front foot hit the ground before the previous foot did and one tends to lean slightly forward and vice versa when walking downhill.

For identification of buses and taxis we tended to use colour clues from previous experience, e.g. taxis are white and red or red and yellow. However, with less than 6/60 vision one couldn't tell the destination of a bus at all and with 6/36 it wasn't possible until the bus was level or actually moving past. When on trains and being unable to read station names on the indicator board or station names on the platform from the train, it was necessary to count the stops for the station required. With 3/60 and 1/60 vision it was very difficult to tell whether the seats were vacant or not.

When crossing at a pedestrian crossing with 6/60 or less it was extremely difficult to tell whether there were any cars approaching and whether they were stopping. When crossing a street without a pedestrian crossing it was frightening and impossible to cross by oneself.

When crossing at traffic lights with VA less than 6/24 it was impossible to read the 'Walk' and 'Don't Walk' signs. Only a red blur was discernable. Thus, one could only tell when to cross when the red blur disappeared, the cars stopped and the people around moved off the footpath. One didn't notice the green blur for the 'Walk' sign appear.

Using escalators didn't prove to be very difficult as they provided clues of movement and colour, e.g. the yellow safety lines.

When going up the stairs the clues of light and shadow, height difference between steps and advertisement stickers on the face of the step, as well as on the railing, made them less difficult.

However, when travelling downstairs these clues were absent. With less than 6/60 VA it was difficult to distinguish individual steps, rather it appeared only as a downward slope. If there was a bend in the railing it gave a clue that the ground levelled out. As you could imagine, it was frightening going downstairs without a railing.

We noticed that many shop fronts consist almost completely of glass, especially those in arcades, and with less than 6/60 it was almost impossible to differentiate the doorways. Clues to the presence of a doorway were a lack of reflection and the absence of posters or stickers on the glass. Without these clues it would be easy to walk into the glass walls.

With low levels of VA we found it much easier to recognise objects that were moving rather than those that were stationary, particularly in the distance. Colours such as red, yellow, light blue and white were far more prominent than others. Thus, these two factors could be utilised in management of visually impaired people.

When travelling in a car a passenger with 1/60 VA cannot see side streets, lane markings on roads, traffic lights until level with them. With 6/18 VA the only difficulty was reading street names and number plates on cars.

Reading

It is just possible to read the blackboard writing sitting three rows from the front with 6/12 visual acuity. Therefore any child with a visual impairment should be placed in a position as close to the blackboard as is possible. We also found it much easier to read blackboard work written with white chalk although yellow, green and blue shades were also seen, but red was hardly discernible.

Colour television we found easier to see than black and white as the colour conveys additional clues.

One of the biggest problems which we encountered when reading was the inability to scan linear print. This became obvious when we attempted to scan a menu with 6/18 visual acuity and found it almost impossible to do so.

The accommodation near point should also be considered as the visual acuity decreases. In order to create a larger retinal image the print is moved closer to the eyes. However, one may bring the print to a point in space closer to the eyes than the accommodation near point, thus print still remains illegible. It is bigger but is blurred. This problem is exaggerated in elderly patients and presbyopes wearing a near correction. Such people would benefit from using an optical aid, for example a hand held magnifier.

Another problem which became evident was one of crowding of the print due to the fine spacing between the letters of a word. This was particularly noticed whilst looking up phone numbers as in the position of maximal clarity there was insufficient space for the letters to be resolved and they appeared jumbled.

Dialling a phone number is a task which we all take for granted. However, this cannot be executed with 1/60 visual acuity relying on visual means. One is required to feel each hole in the disc and count the numbers along.

TABLE 2
Activities Associated with Home Duties

	6/6	6/9	6/12	6/18	6/24	6/36	6/60	3/60	1/60
Identifying stove controls, heat level etc.	P	P	P	P	12"	8"	4-6"	large label only	Red 'on' light only
Power points location Red 'on' dot	P	P	P	P	P	Locate on wall at 6'	1'	6"	Red 'on' only
Hot/Cold taps (not colour coded)	P	P	P	P	P	1'	4"	2"	just
Identify food (supermarket)	P	P	P	P	P	P	12"	*	*

TABLE 3
Identification of Transport

	6/6	6/9	6/12	6/18	6/24	6/36	6/60	3/60	1/60
Identifying a bus further than 20'	P	P	P	P	P	P	P	P	20'
Identifying bus nos – destination	P	P	30'	20'	10'	level	*	*	*
Identifying a taxi	P	P	P	P	P	P	P	colour only	by colour when level
Taxi vacant/engaged	P	P	*	*	*	*	*	*	*
Train indicators, time & desination platform nos.	P	P	P	P	P	5'	from below only	clock only	*
Station name from train	P	P	P	P	P	P	P	just	*
Station indicators names and lights	P	35'	20'	17'	12'	from below	lights only	*	*
Car numberplate	P	50'	30'	20'	level	*	*	*	*
Identifying stop – by display board	P	P	P	P	P	P	P	close range only	*

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TABLE 4
Activities with Detail I

	6/6	6/9	6/12	6/18	6/24	6/36	6/60	3/60	1/60
BLACKBOARD WORK									
a) Back	P	P	Just P	*	*	*	*	*	*
b) Front	P	P	P	P	P	8"	6"	3"	½"
Dialling Phone	P	P	P	P	P	P	P	Feeling	Feeling
& Reading Instructions	P	P	P	P	P	Very Close	Very Close	*	*
Price Labels	P	P	P	P	P	10"	6"	2-3"	*
Banking	P	P	P	P	P	P	*	*	*
Money Identification	P	P	P	P	P	P	Colour and Size	Colour and Size	Colour only
NEWSPAPER									
a) Fine Print	P	P	10"	7"	6"	4"	*	*	*
b) Small headlines (6/60)	P	P	P	P	P	P	P	4"	2"
c) Big Headlines (>6/60)	P	P	P	P	P	P	P	P	P
Paperback	P	P	P	12"	8"	6"	*	*	*
CHILDRENS BOOKS									
a) first reader	P	P	P	P	P	12"	6"	2"	*
b) Beatrix Potter	P	P	P	P	10"	8"	4.5"	*	*
Womens Weekly	P	P	P	11"	9"	6"	*	*	*

TABLE 5
Activities with Detail II

	6/6	6/9	6/12	6/18	6/24	6/36	6/60	3/60	1/60
Phone Book Numbers	P	10"	8"	7"	6"	4"	names at 2"	*	*
Bus Timetable	P	10"	8"	7"	6"	4"	2"	*	*
Typing – Medicine	P	P	P	10"	8"	7"	5"	2"	*
Train Fare Table	P	P	P	11"	8"	6"	*	*	*
Bus Timetable	P	P	P	P	10"	8"	5"	*	*
Watch Face (tell time)	P	P	P	P	14"	12"	9"	4"	2" →*
TV at 8' with 24" screen	P	P	P	P	P	P	3'	10"	8"
Restaurant Menu	P	P	P	12"	8"	4"	*	*	*
Safety Instructions Dog Wash	P	P	P	P	just possible	*	*	*	*

It is also not difficult to imagine the problem a person with defective vision has when confronted by a row of medicine bottles.

The following tables summarise these experiences: P indicates that the task was possible, and completed without much difficulty. If the task could only be done at a closer range, the necessary distance is included. * indicates that the task was impossible at any distance.

In Australia today it has been estimated that the population classified as legally blind exceeds 26,000 people. A further 78,000 people have a severe visual impairment with an acuity ranging from 6/24 to 6/36, and yet another 196,000 have a visual impairment with an acuity of 6/18. Of this number, approximately 50% are over the age of 60 years. However, there are only 5,000 people registered with societies for the visually handicapped, for example, The Royal Blind Society.

Conclusion

Admittedly, our results are largely based on subjective experience. However, they demonstrate that any residual vision is beneficial to an individual with a severe visual impairment if it is properly exploited.

It is also clear that each visual acuity level may be treated as a defineable entity particularly when comparing acuity levels less than 6/24. In fact, an acuity of 6/36 may be more of a handicap than we have previously thought. As would be expected there is a definite difference noticed between visual acuity levels which accelerates as the visual appreciation decreases. Yet significant improvement may be obtained with severe visual impairment by the use of optical aids which will allow the individual a measure of independence which may permit them to pursue their career and interests in life more effectively.

REFERENCES

1. FAYE, E. and HOOD, C. Low Vision. Charles C. Thomas, U.S.A. 1975 p xiii
2. FAYE, E. Clinical Low Vision. Little Brown and Co, Boston 1976 p. 3
3. BIER, N. Correction of Subnormal Vision, Butterworths, London 1970 p. 2, 14
4. The Royal Blind Society – N.S.W.
BIER, N. ibid, 1970, p. 5
5. LYLE and JACKSON's Practical Orthoptics in the Treatment of Squint Fifth Ed. revised by T. Keith Lyle and Kenneth C. Wybar, H.K. Lewis and Co, London 1970, p. 175

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NYSTAGMUS BLOCKING SYNDROME

Susan Cort, D.O.B.A.

Abstract
Nystagmus blocking syndrome is a type of congenital esotropia with features of early onset, large angle and nystagmus on attempted abduction. The characteristics of this syndrome are discussed, together with two case histories. Management usually entails occlusion and surgery. Surgery is generally less predictable than in the uncomplicated congenital esotrope.

Key words
Nystagmus blocking syndrome, congenital esotropia, posterior fixation suture operation.

Nystagmus, which is reduced or absent in adduction is a fairly well recognised entity, and patients can often gain increased visual acuity because of this reduction.

Von Noorden[1] quotes Lafen (1914) and Ohm (1916) as mentioning an entity where infants with nystagmus develop an esotropia to remain in the null point.

Aldestein and Cuppers[1] advanced this concept which they named nystagmus blocking syndrome. In 1966 they documented its features to be:

- esotropia with sudden onset in early infancy, often preceded by nystagmus
- pseudo paralysis of both lateral recti
- appearance of manifest nystagmus as the fixing eye moves from adduction to abduction

Recent authors, namely Gunter Von Noorden[1 2 5] and Craig Hoyt[3] have done much to popularise the syndrome. They both mention the development of abnormal head postures in these children as both eyes are convergent, and the child usually turns his head towards the fixing eye to maintain it in an adducted position. This becomes more obvious when the child's eye is occluded, and in cases where there was no abnormal head posture previously, the occlusion tends to precipitate one.

The incidence of neurological disorders seems to be quite high in patients with nystagmus blocking syndrome. A significant number of reported cases have undergone shunt operations to reduce intracranial pressure (Hoyt, four out of eight cases, Von Noorden, two out of twelve cases).

There seems to be a very fine dividing line between nystagmus blocking syndrome and other types of estropia associated with nystagmus. Some points regarding differential diagnosis should be made clear at this stage.

Nystagmus is not present in adduction but becomes manifest on any attempt to abduct, so that manifest nystagmus is usually seen before the abducting eye has reached the midline. With end point nystagmus, the eye usually has to be in relatively extreme abduction before the nystagmus is manifest.

Nystagmus blocking syndrome can be associated with latent nystagmus but in such cases, the amplitude and often the frequency of nystagmus will increase, and manifest nystagmus will be noted on attempted lateral versions by the time one eye reaches the midline.

Von Noorden[1 2] feels that cross fixation may be misdiagnosed as nystagmus blocking syndrome, especially where there is apparent dysfunction of the lateral recti. However, the cross fixation pattern seen in congenital esotropes does present a different clinical picture as I hope the case histories will show.

The differential diagnosis between bilateral lateral rectus paralysis and nystagmus blocking syndrome is relatively easy as in the former, neither eye will abduct. However, there is debate about the role of mild lateral recti paresis in the genesis of nystagmus blocking syndrome.

Von Noorden feels that lateral rectus paresis does not play a part in its aetiology. He does state that four of his twelve cases had restriction of abduction but these had "complicating factors".

Hoyt[3] on the other hand, feels that lateral rectus paresis does play a part and mentions that four of his cases could have developed lateral recti paresis during periods of high intracranial pressure before undergoing shunt operations.

It is interesting to note that both Von Noorden[1] and Hoyt[3] found that nystagmus was so fine in some cases that nystagmus blocking syndrome was not diagnosed until the patient underwent visuscope examination.

The mechanism of nystagmus blocking syndrome needs more research. One electromyographical study[4] shows that as the fixing eye moves from abduction to adduction there is incomplete inhibition of the medial rectus in the non-fixing eye. Von Noorden concludes from observation that the convergence mechanism is used, and that it is, at least initially, a purposive squint.

Treatment

Early detection of nystagmus blocking syndrome is essential as it effects a poorer prognosis on cosmetic grounds and I feel that the patient's parents should be aware of this.

Naturally, any significant refractive error should be corrected and occlusion is undertaken to strengthen lateral recti if weak through non use, reverse any amblyopia and promote alternation.

However, with occlusion an abnormal head posture may be exaggerated or one may develop where there was none before.

Cosmetically, something has to be done about the size of the esotropia, but surgery is unpredictable. Theoretically with surgical intervention the neutral zone of nystagmus is shifted to the primary position, enabling good visual acuity post operatively. The most common procedure is the recession/resection and often two operations are needed.

Von Noorden[6] suggests the posterior fixation suture operation, or Fraden operation, as a possible procedure. The medial rectus is sutured to the globe behind the equator, therefore reducing its action without effecting innervation to other muscles. But as von Noorden points out this may be insufficient, even if performed bilaterally, and may need to be combined with a lateral rectus resection.

Both over and under corrections are frequent with surgery. The undercorrections usually are acceptable immediately post operatively (as with case no. 2) and often gradually increase in size. One explanation is that the child is reconverging to block nystagmus again, and this theory could explain some surgical failures that remain at their original angle despite 2 or more operations.

Von Noorden puts no explanation forward to explain his overcorrections, but it seems that generally surgery is far less predictable and that the high incidence of neurological disorders could play a part.

In summary, nystagmus blocking syndrome appears to be caused by hypertonicity of the medial recti resulting from the patient's sustained effort to block nystagmus by converging his eyes. The convergence could well be voluntary initially but becomes involuntary with time. The patient presents with a large angle esotropia with sudden onset in early infancy, possibly with a period of nystagmus preceding it, possible paresis of the lateral recti, and often a head turn in the direction of the fixing eye.

The two following cases illustrate some of the features noted above:

Case 1

Wilson – aged 6 years, has Down's Syndrome and is at present in the Macquarie University Down's Syndrome programme. He has a high I.Q.

His large angle right esotropia was noticed almost immediately after birth. Pregnancy and birth were uncomplicated, and there is no family history of squint.

An abnormal head posture of a head turn to the left eliminated his nystagmus and was first noticed at 2 years 10 months, when he was learning to read. He has a small degree of myopic astigmatism which has been corrected and has worn part time left occlusion to encourage alternation.

Ocular movements show full abduction of each eye but with nystagmus and a reluctance to abduct fully. The nystagmus becomes apparent just before the abducting eye reaches the midline. There is very slight bilateral inferior oblique overaction. With his abnormal head posture Wilson has no nystagmus. Cosmetically his squint is unacceptable.

Case 2

Joanna – aged 3½, first presented at 4 months old with a history of a large left esotropia, nystagmus and head turn to the right, from birth. Pregnancy and birth were uncomplicated and family history was unremarkable.

She wore part time (R) occlusion until she alternated freely, with a head turn towards the fixing eye. Nystagmus became apparent in the abducting eye as soon as it moved away from the adducted position. Cosmetically her squint was unacceptable so at ten months surgery (left medial rectus recession 6mm, left lateral rectus resection 7mm) was performed.

Immediately post operatively her squint was cosmetically excellent but over the next two years her angle has increased and at present is 30△BO without glasses, 25△BO with glasses.

Cosmetically her squint is fair to good. She has mild hypermetropic astigmatism in her left eye which has been corrected. Ocular movements show manifest nystagmus in abduction more marked in the right than the left eye. Both inferior obliques overact, with minimal underactions of both superior obliques. Her nystagmus is much reduced post operatively and could now be mistaken for gross end point nystagmus.

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REFERENCES

1. VON NOORDEN, G. K. "The Nystagmus Compensation (Blocking) Syndrome". Am. J. Ophthalmol. Vol. 82, No 2, 1976
2. VON NOORDEN, G. K., "The Nystagmus Blockage Syndrome". Aust. J. Ophthalmol. Vol. 7, No. 1, 1979
3. HOYT, C. S. "Nystagmus Compensation (Blockage) Syndrome". Am. J. Ophthalmol. Vol. 83, No. 3
4. METZ, H. S., and SMITH, G., "Abduction Nystagmus". J. Paediatric Ophthalmol. and Strab. Vol. 15, No. 5
5. BURIAN, H. M. and VON NOORDEN, G. K. "Binocular Vision and Ocular Motility". St. Louis, Mosby, 1974
6. VON NOORDEN, G. K. "The Posterior Fixation Suture Operation". Aust. J. Ophthalmol. Vol. 7, No. 1, 1979

AN ATYPICAL RESPONSE TO OCCLUSION OF A CONGENITAL ESOTROPE

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Abstract
Congenital esotropia of large degree generally has a poor prognosis for functional cure, unless early surgical intervention is undertaken.

Well supervised, pre-operative orthoptics is most important and may produce an unusual response. The congenital case studied was a large angle of deviation, which reduced dramatically following many months of orthoptics, beginning at the age of eight months.

Key Words
Congenital, esotropia, abduction, occlusion, binocular-function.

Introduction

Since 1777 partial occlusion of a sound eye had been suggested and since 1843 has been the orthodox treatment of strabismus when amblyopia of the strabismic eye is evident and was also recommended to "make the squinting eye straight."[1]

In recent times researchers in neuro-physiology, Hubel and Wiesel, have established experimentally with new born kittens, that when binocular pathway stimulation and binocular development is disrupted in early life, there is an anatomical deterioration of the binocular pathways in cells of the lateral geniculate body but no evidence of atrophy of the striate cells in the occipital cortex.[2,3,4] These findings would apply to both onset of strabismus and/or occlusion, as the disruptive factor. Hubel and Wiesel[2] state that "profoundly significant is the early disruption of the binocular pathways and rendering impossible any opportunity for fusion development. These changes seem to become irreversible after three months of monocular deprivation" in kittens. Their most recent findings state monocular deprivation is most devastating from the 4th to the 6th week of life in kittens.

If these findings can be related to human infants at any time, the chances of a congenital strabismus ever gaining functional bincular vision would seem remote.

Review of Literature regarding Congenital Esotropia

1. Worth 1908: – congenital esotropia is due to deficiency in a central fusion centre.[2]
2. Chavasse 1939:– binocular vision is achieved by conditioned reflexes and thus fusion is not an innate faculty and any obstacles to fusion development could be overcome if the deviation is eliminated before 2 years of age.[2]
3. Duke-Elder and Lyle:– little or no proof that functional cure was possible with early surgery.[1]
4. Costenbader 1952:– early surgery during the first 6 to 11 months of life, leaving a residual angle of 10 degrees or less, does result in functional cure.[2,5]
5. Berke 1958:– poor functional results with surgery after 2 years of age.[2]
6. Taylor 1963:– **adequate** surgery at an early age, i.e. 10 degrees or less laterally and 5 degrees or less vertically residual angle results in stereopsis,[6] and in 1967 poor results after 2 years of age.[7]
7. Costenbader and Parkes 1966:– early surgery resulted in 44.5% with gross stereopsis.[2]
8. von Noorden 1971:– 46% functional cure with adequate surgery up to 2 years of age.[8]
9. Taylor:– diagnosis of congenital strabismus cannot be made unless noticed prior to 6

months of age.[2]

10. Hubel and Wiesel:– by electro-medical testing of new-born kittens deduced the binocular pathways are innately determined and fusion faculty is anatomically present at birth.[4]
11. Duane in 1978 stated that "the management of congenital esotropia essentially involves surgically straightening the eyes".[9]
12. Walsh and Hoyt in 1969 stated "in most cases of convergent strabismus, any spontaneous straightening is associated with increasing amblyopia in the squinting eye."[10]
13. Dunlop and Dunlop (1978) found from an extensive survey of congenital squint only 4% gained "fully functional binocular vision"[12]
14. Selm (1974) reviewed 286 cases of congenital and infantile squints (being under 1 year of age) and found that refractive errors, particularly hypermetropia, are an insignificant causative factor in heterotropia of such early onset.[8]
15. Gillan (1945) analysed a series of squints treated with orthoptics alone and stated that 39% became straight or "nearly straight"[13]. It was not stated what treatment was given nor whether the deviations were intermittent or constant, congenital or acquired.
16. Guibor found one non-accommodative 20 degree squint which straightened with orthoptics alone. Again it is uncertain if this case was congenital, constant or intermittent.[14]
17. Costenbader (1958) like Chavasse stated "if vision is adequate in each eye, and binocular alignment is maintained during the first 6 years of life, fusion will often develop spontaneously."[15]
18. Marshall Parkes (1968) concludes that the younger the patient is at the time the congenital strabismus is straightened, the greater the success in the development of binocular single vision.[16]
19. Taylor (1963) concluded that early surgery for congenital strabismus should be carried out from 6 to 12 months of age, to enable the development of fusion and a functional cure.[6]
20. Duckman and Flax, optometrists, (1978) quote 76% overall functional and cosmetic cure by optometric orthoptic treatment of strabismus.[17] Perhaps much of the data tabulated involved intermittent and/or acquired strabismus, as there was no reference to congenital strabismus.
21. Forrest, an optometrist, (1977), cited a single case report of a congenital esotrope who suffered considerable birth trauma and presented at the age of 8 months with a 30 degree squint. With part-time occlusion and extensive "creeping and crawling therapy" and the "discouragement of walking", the angle of deviation finally reduced to 10 degrees with the use of binasal occlusion at the age of 2 years. He concluded that "there is little doubt that the forced lateral excursions had a positive affect on the results".[18] Possibly Forrest's case fits into the Blind-spot syndrome and this made a favourable situation for reduction of angle, once any suppression scotoma was eliminated. Alternatively, possibly it was a VI nerve palsy following birth trauma which recovered.

Case History

I have worked recently with a male infant with evidence of a large congenital constant right esotropia of 58 prism dioptres. Pregnancy proceeded normally and at birth the umbilical cord was around the infant's neck but presented no real problems. There is one cousin with a congenital esotropia. The child was first examined by an ophthalmologist under atropine at the age of 7 months, at which time there was no significant refractive error and fundi and media were normal. Orthoptic management was begun at 8 months of age and consisted of direct and constant occlusion which was not fully effective until 12 months of age and was supervised at regular monthly reviews. On presentation bilateral abduction was poor as is often found with congenital esotropia. Lyle and Wybar[11] suggest the possibility of stretching of the VIth cerebral abducens nerves in the process of moulding the head during birth as a cause. In spite of total and almost constant occlusion there was great reluctance to maintain fixation of the squinting eye. Easy fixation of the right eye was achieved at 17 months of age. I have suspected for some time that infants, in which reversal amblyopia occurs with constant occlusion therapy, have some form of bilateral foveal dysfunction or instability. Although there is no real evidence to support this at present, the incidence of bilateral eccentric fixation with bilateral sub-standard visual acuity which never reaches the now accepted foveal standard of 6/5 is surprisingly higher than one might have expected. At each monthly review a careful evaluation of clinical fixation was made. Much time was spent gauging any improvement of abduction and when able the Catford Drum, visual acuity was regularly assessed. Initially, the recorded visually acuity at 16 months was 6/12 R&L and now at the age of 4 years the acuity is R.6/12 and L.6/9 with Sheridan Gardiner single letters. Visuscopic fixation is R.E. parafoveal, nasal and superior and L.E. central to parafoveal superior.

that increased abduction certainly encouraged the reduction of the angle.

Congenital esotropia, aged approx. 2 months.

Right micro-tropia, aged 3 years.

Results

Reponse to occlusion and increased abduction with the patient described has been most unusual and has avoided surgical correction so far. When occlusion was reduced to part-time and alternating, at the age of 2 years, the angle of deviation reduced dramatically, that is at that time the two eyes were able to function simultaneously for longer periods. Finally, the deviation reduced to a small esotropia of 11 prism dioptres, eliciting gross stereopsis (synoptophore). Abduction increased well at an early stage of management, and is now full. Bilateral overaction of the inferior oblique muscles, which was evident when abduction became full and easy, may present an obstacle to continued development of binocular function.

In my experience, results of early treatment have not been of this nature. This infant, where early occlusion was almost constant, did not seem to have suffered by deprivation of development of binocular pathways, as suggested by Hubel and Wiesel[4]. Also the evidence at present is that this child did not experience any form of binocular function prior to the onset of strabismus, which the parents are adamant was congenital. I consider

CONCLUSION

From the case discussed and other literature available, one realises that active therapy, at the earliest possible age is of tremendous advantage for the patient. One can postulate that once the suppression scotoma is reduced and there is a change in the motor adaptations as abduction becomes a full and easy task, conditions are favourable for encouragement of the desire for single binocular function. If the fusion faculty is present as an innate reflex at birth, the question arises as to why there is not a higher percentage of congenital esotropes gaining normal or abnormal binocular function when treated adequately at an early age?

There are two schools of thought re the prognosis of the congenital esotrope:

1. The earlier the straightening of the eyes, the more chance there is of functional development.
2. The congenital esotrope has almost no chance of gaining any functional cure, therefore early surgery is not always considered.

The described atypical response to early occlusion therapy and ocular mobility supports the former theory. That is, when the infant's eyes are in a straight or micro-tropic position, functional binocular vision may be established. That is, this innate fusion reflex may be developed some time after birth.

REFERENCES

1. DUKE-ELDER, Sir S. "System of Ophthalmology". Vol VI Ocular Motility and Strabismus. Henry Kimpton. London. 1973. p 606.
2. TAYLOR, D. M. "Congenital esotropia." Intercontinental Medical Book Co. New York. 1973.
3. HUBEL, D. H. and WIESEL, T. N. "Comparison of the effects of unilateral and bilateral eye closure on cortical unit responses in kittens." J. Neurophysiology, Vol. 28. 1965.
4. HUBEL, D. H. and WIESEL, T. N. "Binocular interaction in striata cortex of kittens reared with artificial squint." J. Neurophysiology, Vol. 28. 1965.
5. COSTENBADER, F. D. "Factors in the cure of squint." Strabismus Ophthalmic symposium 1. Allen, J. H. (ed) p. 367-369. 1950.
6. TAYLOR, D. M. "How early is early surgery in the management of strabismus." Arch. Ophth. Vol. 77. p752-756. 1963.
7. TAYLOR, D. M. "Congenital Strabismus." Arch. Ophth. Vol. 77. p478-484. 1967.
8. VAN SELM, J. L. "Infantile Squint." Management and Prognosis. Suid-Afrikaanse Argief wi Oftalmologie. Vol. 2. p37-41. 1974.
9. DUANE. "Clinical Ophthalmology". Vol. 1, ch. 12, p7-11. Harper and Son, Hagerstown, Maryland, 1978.
10. WALSH, F. B. and HOYT, W. F. "Clinical Neuro-Ophthalmology" Vol. 1. Williams & Wilkins Co. 1969.
11. LYLE, T. K. and WYBAR, K. C. "Practical Orthoptics in the treatment of squint." H. K. Lewis & Co. Ltd., London, 1970.
12. DUNLOP, P. and DUNLOP, D. "Progress in infant strabismus therapy, analysis of long term results." Aust. J. Ophth. Vol. 7. (1) p57-63. 1979.
13. GILLAN, R. U. "An analysis of one hundred cases of strabismus treated Orthoptically." Brit. J. Ophthal. 29 (8). p420-428. 1945.
14. GUIBOR, G. P. "Early diagnosis and non-surgical treatment of strabismus." Am. J. Child. Vol. 52. p907-915. 1936.
15. COSTENBADER, F. D. "Clinical course and management of esotropia. Strabismus Ophthalmic symposium. St. Louis. The V.C. Mosby Co. 1958. p325-353.
16. PARKES, Marshall M. "Infantile esotropia." Amer. Orthop. J. Vol. 18. p19-22. 1968.
17. DUCKMAN, R. H. and FLAX, N. "Orthoptic treatment of strabismus." Amer. J. Optom. Vol. 49. (12) p1353-1361. 1978.
18. FORREST, E. B. "Treating infant esotropia – a case report." Amer. J. Optom. Vol. 55 (7) p.463-465, 1978.

SECONDARY AND CONSECUTIVE EXOTROPIA

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Abstract
A review of 81 patients with secondary exotropia and 80 patients with consecutive exotropia is presented, and the main characteristics of each type are discussed.

Key words
Secondary exotropia, consecutive exotropia.

The purpose of this paper is to review briefly some of the characteristics of secondary and consecutive exotropia. The records used were those of 721 patients who had undergone surgery for a divergent deviation at the Sydney Eye Hospital.

Secondary Exotropia

81 patients were diagnosed as having a secondary exotropia. Secondary exotropia is said to occur because pathological conditions give rise to gross visual loss[1]. However, for 21 patients the visual acuity was 6/36 or better in the affected eye. It appeared that in these cases the interruption to binocular vision (e.g. by a penetrating injury) had precipitated the deviation.

The remaining patients had visual acuity of 6/60 or worse. Some of these patients had grossly defective vision in both eyes.

33 of the 81 patients with secondary exotropia had undergone previous non-strabismic surgery. It can be seen from the types of surgery performed that an interruption to binocular function and a gross decrease in visual acuity may have occurred.

39 patients suffered from organic lesions causing a 'blind' eye.

Only 23 patients wore glasses, and investigation of the refractive errors proved insignificant. The 7 patients with unilateral aphakia were not optically corrected. Other than for these patients, anisometropia was not evident. This, has however, been described as a factor in secondary exotropia.[1]

TABLE I
PREVIOUS SURGERY

No previous surgery		39
Previous surgery for exotropia		9
Cataract Surgery	– Unilateral	7
	– Bilateral	6
Retinal Detachment		9
Corneal Graft		6
Penetrating Injury		2
Other		3

Hugonnier[2] states that secondary exotropia usually involves a large angle, that is, between 40△ and 60△. The patients in this survey were assessed largely by Hirschberg's method only. It can be seen from Figure 2 that the majority of patients in this survey who had surgery for a secondary exotropia had an angle of at least 40△, with 9 being greater than 60△.

TABLE 2
ANGLE OF DEVIATION

Less than 40 prism dioptres	21
40 to 60 prism dioptres	31
Greater than 60 prism dioptres	9

Consecutive Exotropia

Consecutive exotropia occurs where, through the passage of time or following enthusiastic surgery, a previously convergent eye diverges. This paper analyses only those with post operative consecutive exotropia. It is amazing to think that during 41 years of surgery and the several thousand cases of esotropia operated on in that time, only 82 patients were found to require surgery for this condition.

The majority of patients had undergone 1 operation for esotropia. 9 patients had already undergone surgery for consecutive exotropia.

TABLE 3
PREVIOUS SURGERY FOR ESOTROPIA

	Number of operations
One	44
Two	16
Three	8
Four	3

88% of those with consecutive exotropia showed no evidence of binocular function. Vallaseca, as reported by Hugonnier[2], suggests pseudoparalysis of the medial rectus due to adhesions as a feature of consecutive exotropia. 42% of the patients in this series showed underaction of one or both medial recti before exotropia surgery. Perhaps this occurs due to inadequate ocular motility exercises following the initial operation. Over recent years this appears less of a feature. This may be due to the fact that orthoptists now encourage these movements post operatively.

Only 32% of these patients had equal visual acuity pre-operatively. 25% showed 1 line difference, the remaining 43% with more than one line difference.

REFERENCES

1. LYLE, T.K. and WYBAR, K.C. "Practical Orthoptics in the Treatment of Squint" 5th Ed. 1970 p. 326
2. HUGONNIER, S. and HUGONNIER, R. "Strabismus, Heterophoria, Ocular Motor Paralysis" C.V. Mosby Company, St. Louis 1969

CASE HISTORY: RECURRENT SIXTH NERVE PARALYSIS IN A CHILD

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At age 2.11/12 K.L. presented with a large left esotropia obvious since a recent unspecified illness. The ophthalmologist noted a marked compensatory posture of a face turn to the left, and suspected a left lateral rectus underaction. Atropine refraction revealed minimal hypermetropia and no lenses were ordered.

At the first orthoptic assessment no head posture was noted. No manifest deviation was evident and there was full abduction of the left eye. It was suggested that a further assessment be made in the near future, however the patient did not present again until twelve months later.

At this visit the mother reported that since a bad case of mumps with a very high temperature, a large left esotropia with an abnormal head posture had again been noted.This posture of a face turn to the left with the chin down was very obvious. A left convergent squint of +15° in the primary position was well controlled with this head posture. There was no apparent abduction of the left eye beyond the midline.

Two months later there had been no change in squint or head posture. Visual acuity was assessed by the "E" chart at 6/9 right and left. An angle of +20° (F.R.) with N.R.C. was obtained at the synoptophore. The patient fused at this angle with a small range.

Four months later no squint or head posture had been noted for some time. Cover test revealed a well controlled esophoria with full abduction of the left eye. Six months later the eyes were still straight.

At the sixth orthoptic visit the squint and head posture were again evident, and, according to the mother, had been present since a severe bout of bronchitis associated with fever. A Hess chart showed a typical left lateral rectus paresis.

The opinion of a paediatric neurologist was that neurological examination was normal, and that further electrophysiological and tensilon tests were not indicated. A right medial rectus recession was considered.

At the next assessment no squint or head posture was evident. A well controlled esophoria with full abduction of the left eye was present. Surgery was therefore deferred.

Six months later the eyes remained straight, with full ocular movement and equal vision. An angle of +3° with N.R.C. was measured at the synoptophore. The Hess chart showed a slight esodeviation only.

Mother reported that K.L. was now receiving long term penicillin treatment for her bronchial problem and had been relatively well, and that no squint or head posture had been seen.

It seems apparent that there is a definite relationship between the onset of a sixth nerve paralysis and the presence of illness with a high fever in this patient.

My thanks to Dr L. Cebon for allowing me to present this case.

PROBLEMS ASSOCIATED WITH THE INTEGRATION OF THEORY AND PRACTICE IN CLINICAL ORTHOPTICS

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Abstract
Some of the college and clinical experiences which are used to help the student gain the best possible professional behaviour are considered. The discussion looks at the individual students' experiences and performance in the classroom, the clinic and during assessment. Some of the current problems are identified and the potential solutions described.

Key words
Teaching methods, comprehension and assimilation of material, application of material, professional competence.

Modification of teaching methods over the last four years has generally improved the students' performance, although it continues to indicate difficulty applying theory to practice.

The following discussion looks at five areas in which problems occur:

I The teaching of the individual student in the classroom
II Control of individual student experience in clinical education
III Nature and level of graduate behaviour
IV Communication to clinical teachers of the standard of course content
V Assessment of student clinical performance

Teaching of the Individual Student in the Classroom

Two problems arise in this area:

1. Comprehension and assimilation of concepts into the students' existing knowledge framework. These concepts include phenomena not immediately demonstrable in practice and the total management of patients whose treatment continues for longer than the scheduled period of attendance at one clinic.

Depending on each students' previous clinical performance and comprehension of basic studies the new material will be understood at different levels. The initial problem is to detect the individual student who does not understand the material and to assist his/her comprehension. Few are willing to admit that a concept was not understood, particularly when in a group, and deficiencies may be overlooked until revealed at a major assessment, where the question is one of pass or fail.

2. Application of theory to the patient. One of the aims of presenting theory is to increase the breadth and depth of the individual's knowledge in as short a time as possible. The student has to be prepared to apply his theoretical knowledge to the patient and then to assess the results so that in the light of experience he can develop his own ideas. The relationship of theory to the case and the case to theory is poorly understood and forms a basic problem.

To assist comprehension of concepts, variety in the method of presentation of material is used and information is related as much as possible to practical situations.

The methods include small group tutorials, assessments, academic practical tutorials, progressive case studies, simulation and audio-visual sequences. The first three methods, by various approaches, enable feedback to the student of the development of his academic abilities. Initially this involves the ability to recall knowledge by assessments such as viva voce and multiple choice questions. As the training progresses the student is encouraged to apply, assess and analyse information, through case studies in both clinical and discussion sessions. These methods also provide the lecturer with information on individual student comprehension and performance.

Progressive case studies have been introduced to help to give the student the concept of total case management. The student, through personal contact and case history information follows and reports the progress of a treatment programme. This has been particularly useful where student participation is limited due to risk of injury to the patient, e.g. tonometry and contact lens work.

Simulation has been more recently introduced and by presenting a less stressful ordeal is playing an increasingly useful role in training. In the initial stages of training devices which simulate basic conditions (e.g. cover test doll) are used and to reinforce experience fellow students, staff and willing assistants are used to simulate patients.

Games are used for more complex conditions (which cannot be simulated by unaffected patients). The "patient" is programmed to make specific responses as the student verbally carries out the test sequence. A pre-arranged scoring system has marks assigned for such things as sequencing of tests, methodology and interpretation of results.

Control of individual student experience in Clinical Education

To ensure that the graduate will adapt his techniques to a variety of human conditions, it is essential that he demonstrates proficiency in basic skills at an undergraduate level. His performance will depend on background training and on experience in the clinics. It is the latter which, in my experience, requires control.

Three problems arise in this area, the first being that clinics are predominantly non-specialist and can rarely be controlled to ensure that specific conditions will be available when required or when most applicable to theoretical presentation. Thus students can miss essential experiences, unless special arrangements are made. Such monitoring is complex and binding for staff and students.

The second problem occurs where, through the generosity of the practitioner, students participate in regular practice. Often there are too many patients to allow any discussion in depth. Potentially valuable experiences pass unexplained, and recently introduced ideas cannot be reinforced.

The third problem is the limited availability of clinics. Placements may be fragmentory, resulting in lack of continuity of tuition for the students.

Methods used to overcome these problems include rotation of students, log books, work books, videos, case discussions and structured practical tutorials.

Of these, most orthoptists are familiar with the rotation of students with the associated advantages, and clinic books which now record in more detail the kind of clinical experience gained so that further placements can be arranged appropriately.

Work books and progressive case studies are also collected. These are assessable and require experiences in essential areas before they can be completed and marked according to acceptable standards. Additionally, case studies are carried out in small groups to encourage the development of logical thought processes to enable adaptability in clinical situations.

Structured practical tutorials and rotation of students with a limited patient load per session are a recent addition, thereby allowing full discussion of all aspects of patient management.

Videos are also used to ensure essential ocular conditions have at least been observed.

Nature and level of graduate behaviour

Undergraduate studies are designed to develop a competent beginning practitioner.

The problem is how to assist the students to develop professional behaviour, so that on graduation they can demonstrate a mature approach to care of the patient.

Methods used to try to achieve this aim include "problem-solving" exercises, assignments and research papers and seminars.

In "problem-solving" exercises, case studies, simulation and patient examination are used to present limited informaiton which the student is led to think through in order to reach a diagnosis, discuss further possible tests which could be used with the likely results, and to outline the most appropriate plan for any given patient.

Assignments and research papers are set on topics developed to simulate logical collection and sorting of data, with discussion of results, and statement of ultimate conclusions.

Seminars are also set with the presentation guided so that the student collects and presents new information to colleagues in a way which can be easily assimilated and promotes group discussion.

Communication to clinical teachers of the standard of course content

Considerable time and effort is involved in presenting lecture material so that it can be readily applied in clinical practice. Again and again we find that the opportunity to apply it has not been given, and the problem arises as to how best to communicate to clinical teachers the material which has recently been covered in lectures to enable maximal reinforcement to students.

The ideal solution for this problem would be practical sessions supervised by the lecturer or attendance at lectures by clinical teachers, however, both situations are highly impractical due to other commitments.

More feasible solutions lie in methods such as forwarding handouts to clinical teachers so that, at their leisure they can assimilate the material. This tends to be tedious and does not fully explain all the material.

Another possibility at present being tried involves the circulation of the objectives of each lecture with the inclusion of limited added information to inform and control the level of expectation for each year.

Meetings and workshops are also organised for clinical teachers where lecture content can be discussed to enable additional areas of communication though these do hold some limitations.

Assessment of student clinical performance

Assessment, while it produces dread in both examiner and student, has some valuable and positive aspects. For the examiner these are identification of areas of poor comprehension and students with sub standard performance. To the student, on the other hand, it provides a powerful stimulus to pull information together into a total concept and to gain feedback on their personal competence level.

There are however, problems associated with assessment, such as stress, which affect students' performances, particularly if they are shy or lack confidence and may also be aggravated by time constraints.

Additionally, lack of objectivity in assessment can arise because the examiner may vary from the student in their value judgements due to differences in experience and academic background, the personality of the examiner and student may be antagonistic, the standard of previous student performance may influence expectations and marks, e.g. "star student" and in the more complex areas variability in patient personality, condition variety and complexity can occur. Regardless of student capability, the examination can be straightforward or very complicated.

To overcome stress, assessments can be organised so that they cover a variety of tasks including the regular form of examination of patients and written submission, both of which conform to established objectives for assessment of the topic. Assessment by regular clinical teachers incorporated into a regular clinical session where relationships and patterns of practice are familiar and thus less threatening, can also help. As well, the format of timed examination can be organised to allow analysis of performance followed by discussion to clarify areas of discrepancy and omissions.

To assist objectivity in basic areas, assessments can be organised which use simulated patients. This removes a considerable amount of variability between patients. However, simulation within complex areas makes it difficult to retain credibility. Additionally the objectives of the examination identify the components considered necessary to produce clinical competence so that a marking plan can be stated with its appropriate loading.

Finally, the averaging of multiple assessments with several examiners can reduce the effects of examiner subjectivity.

REFERENCES

1. NEWBLE, D. J. "Evaluation of Clinical Competence". ACUE, 1977, The University of Adelaide.
2. de JERSEY, M. "Integration of Theory and Practice in Clinical Education" Ed. Endre Szekely, NSW College of Paramedical Studies, 1974.
3. HARTE, C. "General Principles Concerning Clinical Experience and Assessment" Ed. Endre Szekely, NSW College of Paramedical Studies, 1974.

A SURVEY OF THE CLINICAL EVALUATION OF STEREOPSIS IN AUSTRALIAN ORTHOPTICS

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Abstract
A questionnaire which was intended to assess the relative importance of stereopsis evaluation in Australian orthoptics was sent to 189 orthoptists. This preliminary report analyses the answers given on the first seventy-one replies. Ninety-four percent of the replies stated that the orthoptist routinely tested stereopsis, the tests used included the Wirt-Titmus, synoptophore-based, TNO, Frisby and Lang Pen tests. The tests which were nominated as most frequently used were the Wirt-Titmus (54% of replies) and synoptophore-based stereotests (42% of replies). The test which was regarded as most reliable was the TNO test (50% of those who knew of the test). Efficient evaluation of stereopsis was regarded as important or very important by 95% of the replying orthopists.

Key Words
Stereopsis, orthoptists' questionnaire.

Orthoptics has been defined as "The practice of methods (usually exercises), other than optical or surgical, for treating anomalies of binocular vision, and for overcoming deviation of the visual axis, whether such deviation be manifest or latent, and of helping to restore comfortable binocular single vision."[1] In its ultimate form, binocular single vision expresses itself as stereoscopic depth perception. In the light of the above definition it would seem to be of fundamental importance for the orthoptist to assess the quality of all patients' stereopsis. Definitions, however, do not necessarily reflect attitudes formed by experience; it is the latter which will determine whether or not a given test is performed. It does not matter how good a stereotest appears under strictly controlled laboratory conditions, if it is found wanting in the clinic it will not be widely used. In recent years a number of new stereotests have been introduced: the Frisby test[2] Random Dot E[3], Randot[4] and TNO test[5]. All of these tests have yielded encouraging results in initial trials, but it is reasonable to ask whether they have been accepted by orthoptists in general. In order to find out, a questionnaire was prepared and sent to 189 Australian orthoptists. Only orthoptists with two or more years experience were petitioned. This article is a report of the answers given in the first seventy-one replies.

THE QUESTIONNAIRE

The questionnaire was headed by a short note explaining the motivation behind it. The note stated that the author "would value your (the orthoptist's) help in assessing the relative importance of stereopsis evaluation in Australian orthoptics". Replies to the questions were returned anonymously.

The orthoptist was asked to answer nine questions. The first (unnumbered) question requested that the respondent specify the city in which he or she was trained. This should have revealed any overall differences in the answers which could be accounted to the school of training. Eight numbered questions followed, they are detailed in Table One, along with the results.

Question One was intended to reveal whether the orthoptist in general uses tests of binocularity alone (Worth 4-dot test, cover test, prism test, etc.), or whether he or she considers the stereotests to be worthy of routine use.

Questions Two to *Seven* were intended to indicate which tests for stereopsis are presently used in the clinics *(Questions Two* and *Three),* how widespread has been the acceptance of the recently introduced stereotests *(Question Four),* whether or not stereopsis evaluation is regarded as a useful means of screening for amblyopia *(Question Five)* and which of the presently used tests are regarded as unreliable indicators of stereoscopic ability *(Questions Six and Seven).*

Question Four is of particular interest in that it revealed the proportion of the respondents who, considering that they knew the newer tests well, actually use the tests. If a reply to this question had some of the tests marked "Personally used", "Well known" or "Heard of" and some of the tests unmarked, then the unmarked tests were treated as if they were marked "Not known".

Much recent research has been devoted to the potential use of tests for stereopsis as stand-alone screening tests for amblyopia[3,5,6,7]. Results have, in the main, been interpreted as favourable by the various researchers. *Question Five* sought to reveal whether or not orthoptists, as a body, agree with the conclusions of these workers.

All of the stereotests which are used at present are considered to have flaws of one form or another, for example recent projects have found that the results of the Wirt-Titmus may be contaminated by the influence of lateral displacement cues[8] and the TNO test may be dissociative[9,10]. In practice these flaws may be significant, in which case the tests will not be reliable. *Question Six* asked the orthoptists to specify which tests, if any, they considered unreliable and *Question Seven* asked them to state which tests were *most* reliable.

Question Eight may be looking somewhat into the future, as it asks the respondent to rate the importance of *efficient* stereopsis evaluation. Each of the answers to this question was grouped into one of four categories:

a) *Very important.* If the answer stated that stereopsis evaluation was an essential aspect of the assessment of binocular vision, if it rated stereopsis evaluation as "vital", "extremely" important, "most" important etc., or if the orthoptist felt that stereotests should be performed as screening tests for certain occupations, the answer was categorised as *very important.*
b) *Important.* If an efficient stereotest was considered to be a good supporting test for the other tests of binocularity, or if effective stereopsis evaluation was considered "important", the answer was placed in this category.
c) *Useful.* This category contained answers which claimed that stereopsis evaluation could only be considered the "junior partner" of the other tests for binocularity, that is, of limited value when compared with the other orthoptic tests.
d) *Not useful.* This category requires no explanation.

RESULTS

(Refer Table 1 Page 85)

The results of the initial seventy-one replies to the questionnaire are detailed in Table One. Parentheses ( ) enclose figures expressed as a percentage of the total number of replies. For the results of *questions six and seven* brackets [ ] enclose responses expressed as a percentage of orthoptists who had *heard of* the particular test in question.

Forty-four of the orthoptists who replied were Sydney trained, twenty-three were Melbourne trained and four were trained in the United Kingdom.

Question One.

Sixty-seven (94%) of the respondents indicated that they routinely test for stereopsis. One of the four negative responses was accompanied by a note stating that the orthoptist worked in a situation which did not allow routine stereotesting to be carried out.

Question Two.

Six different tests were nominated as personally used by the orthoptists. Sixty-seven of the respondents use the Wirt-Titmus test and sixty-five use the synoptophore-based stereotests. The TNO test is used by thirty-five of the orthoptists and eleven indicated that they use the Frisby test. Four replies nominated the Lang Pen test and one nominated a distance stereotest with vision projector chart (Topcon).

It is apparent that most orthoptists use more than one stereotest. Fifty percent of the group actually use three or more tests. Apparently more than one test is required to cover a reasonable range of stereoscopic situations, including near and far viewing, foveal and peripheral stimulation and patient age.

Question Three.

Once again the Wirt-Titmus test scored the highest number of responses (38). This was followed by the synoptophore-based tests (30), the TNO test (13) and finally the Frisby test (3). These figures indicate that some orthoptists used two or more tests with equal frequency.

Question Four.

From the table it is apparent that, of the newer tests, a relatively high proportion of orthoptists had heard of the TNO (89%) and Frisby (83%) tests. The Random Dot E test was known to 67% of the group and the Randot test was known to 38%.

Of the people who had *heard of* these tests, the following proportions either used them personally or considered that they knew the tests well. For the TNO test 94% fell into one of these two classes. For the Frisby the figure was 49% and the Random Dot E and Randot tests were well known to 17% and 19% respectively.

Nobody used the Random Dot E or Randot tests personally, 68% of the orthoptists who knew the TNO test well used it personally and 41% of those who knew the Frisby test well actually used it. The more traditional tests, the Wirt-Titmus and synoptophore-based tests, were used personally by almost everyone (93% and 94% respectively).

The results of this question correlate fairly well with those of question two. Other tests which were used personally and marked as such in question four were card stereograms (3 people), Lang Pen test (3 people), Topcon projected stereotest and Haag Streit projection (1 reply each).

Question Five.

The answers to this question were divided into an indecisive ratio. Thirty-nine replies stated that stereotests are useful screening tests for amblyopia and twenty-six stated that they are not. Six replies were non-committal. The answers to this question displayed a slight dependence on school of training. Of the Sydney-trained orthoptists, 59% answered YES and 34% replied NO. The Melbourne-trained group were more evenly divided on this question: 48% YES and 43% NO. Because the Melbourne-trained group only consisted of twenty-three people, these figures must be treated with caution.

Question Six and Question Seven.

None of the tests were universally regarded as either reliable or unreliable. The TNO test scored the best with 50% regarding it as most reliable and only 9% regarding it unreliable. The Wirt-Titmus test as a whole was regarded most reliable by 46% of the respondents. A further 10% regarded the "circles" subtest as most reliable and 9% felt that the "fly" subtest was unreliable. The test as a whole was considered unreliable in 21% of the replies. 18% of the group considered the synoptophore-based tests to be unreliable while 42% considered them most reliable. For the Frisby test the percentages were: most reliable 20%, unreliable 10%. Very few people were willing to venture an opinion on the relative merits of the Randot and Random Dot E tests; 7% and 8% respectively regarded the tests unreliable indicators of stereoscopic ability, 7% and 4% respectively rated them most reliable.

One of the orthoptists interpreted *Question seven* in a different way. She stated that a reliable indication of stereopsis in a patient was a quick response to any of the tests.

Question Eight.

The response to this question was very clear-cut. None of the replies stated that it was of no use to evaluate stereopsis. Only two replies (3%) were placed into the *useful* category. Sixteen replies (23%) rated efficient stereopsis evaluation as *important* and fifty-one (72%) rated it *very important.* The two remaining replies could not be categorised.

Results which show a dependence on school of training.

Only four of the people who replied were trained outside of Australia. This is too small a number to use in any regional analyses of the results. The remaining replies came from people trained in either Sydney or Melbourne. Most of the results showed no significant dependence on school of training. The answers to the question on amblyopia screening have already been discussed in this regard. There is, however, one other result which deserves mention. A higher proportion of the Melbourne-trained orthoptists have heard of the Frisby test, 91% as compared to 77% for Sydney trainees. Furthermore, of those who have heard of the test, a higher proportion of the Melbourne-trained people use the test personally (29% as compared to 15%). They also regard it as less unreliable than do the Sydney-trained respondents (4.8% of those who know of the test as compared to 12%) and a higher proportion of those trained in Melbourne nominated the Frisby test as most reliable indicators of stereoscopic ability (38% compared to 6%). However it must be re-emphasised that these figures should be considered with care as both groups are small. It is also possible that these figures could be a reflection of the place of present employment, rather than school of training. The present data set cannot be used to address this possibility.

DISCUSSION

The results of this survey show that the orthoptists in general regard the evaluation of stereopsis as an important aspect of orthoptic practice. The vast majority of the orthoptists who replied to this survey presently evaluate stereopsis on a routine basis despite the fact that they often regard the tests which they are using as unreliable. Of the newer tests, the TNO test is the most widely used, although the more recently introduced Frisby test appears to be establishing itself very rapidly. Nevertheless many of the orthoptists who know the newer tests well still persist in using the older Wirt-Titmus and synoptophore-based tests. It is not clear from the replies whether this is due to force of habit or because the more modern tests have not been found significantly better than the old ones.

Eleven of the replies stated that there was a need for a new, efficient, test for stereopsis. The specifications given for new tests included: suitable for use with *very* young children, a minimum of instrumentation, reasonable cost, better method of grading stereoscopic ability, a new test for viewing at six metres, preferable to have a free space test, suitable for use with all types of patients and that the test be easy to administer. While it would seem difficult to meet all of these and other necessary criteria with a single test, the results of the survey show that if and when such a test is developed, it will be accepted rapidly by many Australian orthoptists.

REFERENCES

1. LYLE T. K., WALKER M., Lyle and Jackson's Practical Orthoptics in the Treatment of Squint, H. K. Lewis and Co. Ltd., London, 1953, p.358.
2. SASIENI L. S. The Frisby Stereotest, Optician, 1978, 176 (4544), 7-10.
3. REINECKE R. D., SIMONS K., A New Stereoscopic Test for Amblyopia Screening, Am. J. Ophth., 1974, 78 (4), 714-721.
4. COOPER J., Clinical Stereopsis Testing: Contour and Random Dot Stereograms, J. Am. Optom. Ass., 1979, 50 (1), 41-46.
5. WALRAVEN J., Amblyopia Screening with Random-dot Stereograms, Am. J. Ophth. 1975, 80 (5), 893-900.
6. ROSNER J., The Effectiveness of the Random Dot E Stereotest as a Preschool Vision Screening Instrument, J. Am. Optom. Ass., 1978, 49 (10), 1121-1124.
7. SIMONS K., REINECKE R. D., A Reconsideration of Amblyopia Screening and Stereopsis, Am. J. Ophth., 1974, 78 (4), 707-713.
8. COOPER J., WARSHOWSKY J., Lateral Displacement as a Response Cue in the Titmus Stereo Test, Am. J. Optom. Physiol. Opt., 1977, 54 (8), 537-541.
9. HINCHLIFFE H., Clinical Evaluation of Stereopsis, Brit. Orthopt. J., 1978, 35, 46-57.
10. HILL M., PERRY J., WOOD I. C. J., Stereoacuity in Microtropia, in: Orthoptics: Past, Present, Future, Ed. Moore S., Mein J., Stockbridge L., Stratton Intercontinental Medical Book Corporation, N.Y., 1976, pp. 25-29.

TABLE 1

1. *Do you routinely test for stereopsis?*

YES 67 (94%)	NO 4 (6%)

2. *Which tests for steropsis do you use?*

FRISBY	LANG PEN	SYNOPTOPHORE	TNO	TOPCON PROJECTED	WIRT-TITMUS
11 (15%)	4 (6%)	65 (92%)	35 (49%)	1 (1%)	67 (94%)

3. *Which tests for stereopsis do you use most frequently?*

FRISBY	SYNOPTOPHORE	TNO	WIRT-TITMUS
3 (4%)	30 (42%)	13 (18%)	38 (54%)

4. *Which answer is most applicable to each of the following stereotests?*

	PERSONALLY USED	WELL KNOWN	HEARD OF	NOT KNOWN
FRISBY	12 (17%)	17 (24%)	30 (42%)	12 (17%)
RANDOM DOT E	0 (0%)	8 (11%)	40 (56%)	23 (32%)
RANDOT	0 (0%)	5 (7%)	22 (31%)	44 (62%)
SYNOPTOPHORE	67 (94%)	3 (4%)	1 (1%)	0 (0%)
TNO	41 (58%)	18 (25%)	4 (6%)	8 (11%)
WIRT-TITMUS	66 (93%)	3 (4%)	2 (3%)	0 (0%)

5. *Would you regard stereotests as useful screening tests for amblyopia?*

YES 39 (55%)	NO 26 (37%)

6. *In your opinion which, if any, of the above tests for stereopsis are unreliable indicators of stereoscopic ability?*

FRISBY	RANDOM DOT E	RANDOT	SYNOPTOPHORE	TNO	WIRT-TITMUS	FLY SUBTEST
6 [10%]	4 [8%]	2 [7%]	13 [18%]	6 [9%]	15 [21%]	6 [8%]

7. *Which are most reliable indicators of stereoscopic ability?*

FRISBY	RANDOM DOT E	RANDOT	SYNOPTOPHORE	TNO	WIRT-TITMUS	CIRCLES SUBTEST
12 [20%]	2 [4%]	2 [7%]	30 [42%]	32 [50%]	33 [46%]	7 [10%]

8. *If a truly efficient stereotest is available or became available, how important would you regard stereopsis evaluation?*

VERY IMPORTANT	IMPORTANT	USEFUL	NOT USEFUL
51 (72%)	16 (23%)	2 (3%)	0 (0%)

Table One
Details of the answers given on the first seventy-one replies to the questionnaire. Figures enclosed by parentheses ( ) are expressed as percentages of the full seventy-one replies. Figures enclosed by brackets [ ] are expressed as percentages of those orthoptists who had *heard of* the particular test in question. Percentages are given to the nearest whole number.

Australian Orthoptic Journal, 1979-80, Vol. 17

THE FOURTH INTERNATIONAL ORTHOPTIC CONFERENCE

BERNE 1979

The 4th International Orthoptic Conference was held in September this year in Berne, the seat of the Government of Switzerland, a truly delightful city set around the river Aare, midst beautiful scenery.

The meeting was held in the Kursaal, one of Berne's public buildings, on a hill overlooking the city. Scientific sessions took place in a large semicircular hall with ample, comfortable seating around tables. Other functions were held in surrounding rooms and general facilities were excellent. The Swiss authorities encouraged us to enjoy our stay and provided free public transport throughout the city for all delegates. This was particularly helpful as the 1,000 participants (from Australia to Yugoslavia) were scattered all over the city in 41 hotels.

Australia was well represented by 34 participants (ophthalmologists and orthoptists). It was particularly pleasing to see some of our newer graduates had made the effort to attend this meeting.

Scientific papers were given during morning and afternoon sessions for three days in either English, French or German with simultaneous translation available to delegates via earphones. Film sessions ran simultaneously and it was often difficult to decide whether to listen to the papers, have coffee (which also ran simultaneously in another hall) or watch the films. The quality of the films was particularly good and one hopes that some of these films will be available to orthoptists at a later date.

This congress marked the first Burian Lecture in honour of Dr. Herman Burian, the distinguished American Ophthalmologist who died just before the 3rd International Orthoptic Congress in 1975. Dr. Gunther von Noorden introduced Nancy Capobianco of Italy who gave this inaugural lecture — her topic was "Points of view about sensorial adaption in strabismus". Nancy is the first ever Professor of Orthoptics.

Then followed a short session on Nystagmus and another on Surgery during which co-author Shayne Brown read Prof. Billson's paper on "The surgical management of vertical deviations". The Margaret Fitton Memorial Lecture was given by Joyce Mein (U.K. and one of our distinguished honorary members) entitled "Dissociated vertical divergence and its association with nystagmus".

Joyce gave an excellent paper and her delivery was a lesson to us all — slides, clarity of theme and timing. As always, we can learn a great deal from her. Joyce is also the Chairman of the Permanent Scientific Committee of the International Orthoptic Association and she must be congratulated on the very good scientific section of the Berne Meeting. Her balanced choice of papers presented, shows her keen knowledge of factors both political and scientific.

On Tuesday afternoon 3 hours was set aside for Amblyopia — Diagnosis and Treatment. A very important session. Various methods of treatment were reported including Dr. H. Maclean and Mary Carter's paper on their routine of miotic therapy. Some of you may have heard an early version of this paper at our Singapore meeting.

Ruth Banks and Fay Barnett gave us further insight into their new, alternative method of treatment of amblyopia. Win Barnard, from Moorfields Electro-physiology Labs in London showed us some surprising effects of occlusion on the visually evoked response, in amblyopia.

There appears to be good evidence to show that occlusion of the immature eye may have extremely serious, far reaching effects. As orthoptists we must keep abreast of the new knowledge which is coming from the neuro-physiologists, for the ultimate benefit of our young patients. We, in the clinical setting, must try to understand these new concepts and utilise them. Since the work of Hubel and Wiesel, the advance of knowledge concerning binocular function, amblyopia and the relationship of spatial frequency and contrast ensitivity to visual acuity has so changed our work in orthoptics that we must now have a much deeper understanding of the physiology of vision and cerebral function if we are to be worthy of a place in the team of specialists in the field of eye care.

Wednesday morning's papers were on Neurology and Incomitant Strabismus including an interesting paper on "Ophthalmoplegic migraine of childhood and adolescence. A disorder of 3rd, 4th and 6th cranial nerves", from Canada. This was followed by a group of papers on "Development and Developmental Disorders" which included Vivienne Gordon and Linda McKenzie's very good paper on "Disorders of ocular motility in patients with spina bifida". Vivienne gave us a foretaste of this in Singapore at our last conference; you may recall her excellent slides. The morning concluded with a session of Electrophysiologic Studies.

During Wednesday afternoon, Binocular Vision was the first theme and Mary Wesson's paper on sensory function was extremely interesting. Her use of the Lee's adaption of the Hess screen examination suggests that a wider use of this technique would be of advantage.

Next followed papers on Divergent Strabismus under the able chairmanship of Barbara Lee (Secretary General of the International Orthoptic Association). We hope to welcome Barbara to Australia next year at our meeting and the International Orthoptic Association meetings. "Factors influencing the surgical result of divergent strabismus" was the title of Dr. Frank Martin's interesting paper, the co-authors of which were six staff orthoptists at Sydney Eye Hospital. This paper illustrated the happy result of a team effort.

Thursday morning opened bright and clear with delegates still keen and eager for more; the first topic was Diagnostic Tests. Papers ranged from the Bielschowsky head tilt test to the controversy between atropine and cyclogyl for refraction of esotropic children; from tests on the phase difference haploscope to the evaluation of various tests for stereopsis. Our paper (Dunlop and Neill) "Exploring the spatial and temporal parameters of stereopsis" was read during the session. This paper introduced a new type of test for stereopsis which demonstrates the difference between global and central stereopsis, and also includes the time element.

The morning session continued with papers on "Treatment":– the use of prisms, the consequences of lens implantation for unilateral cataract, surgical treatment of esotropia and exotropia, etc. One novel line of treatment was the use of botulin injected into the extra-ocular muscle thereby temporarily controlling the deviation.

One criticism voiced by several delegates – speakers and participants alike, was the lack of printed abstracts of the papers in the programme. This would have made it easier to choose whether one should listen to the papers or watch the films at any specific time.

An extensive trade exhibition was held in an adjacent hall with all the well known British, American and Continental instrument houses showing the latest equipment, including some new stereo tests and another near vision test for children with reading matter structured to maturity level.

On the whole, the congress was a great success both scientifically and socially and the organisers are to be congratulated on their efforts.

The 5th International Orthoptic Conference is to be held in Cannes (South of France) in October 1983.

Patricia Dunlop

Abstracts of papers read at 4th International Orthoptic Congress by Australian authors:—

SURGICAL MANAGEMENT OF VERTICAL DEVIATIONS

F. A. Billson F.R.A.C.O., F.R.A.C.S., F.A.C.S. and S. A. Brown D.O.B.A.

Abstract
131 cases of vertical deviation are reviewed and the principles of management are discussed in the light of the type and frequency of the surgery required.

The study reveals IV nerve palsies are the most common cause of vertical deviation. The need for superior oblique surgery is infrequent in contrast with surgery to the inferior oblique muscle which constitutes 80% of the surgery performed for vertical deviations.

More than half the patients in the series did not require surgery and of these half required no treatment at all.

MEDICAL THERAPY FOR AMBLYOPIA AFTER FAILURE OF CONVENTIONAL THERAPY

H. Maclean MB, Ch.B, F.R.C.S. (Ed.), D.O. and E. M. Carter D.O.B.A.

Abstract
A series of 55 children with amblyopia resistant to patching, pleoptics or atropine have been treated by atropinisation of the dominant eye combined with stimulation of the amblyopic eye by phosphaline iodide. 31 met the success criterion of 2 Snellen lines improvement in visual acuity. Older children did well and the duration of therapy necessary did not correlate with age or with the degree of atropine blur produced. Eccentric fixation also responded well. The mode of action of this treatment cannot be satisfactorily explained as a variety of penalization, and remains speculative. Side effects were few and not serious. Patient acceptance was good.

FACTORS INFLUENCING THE SURGICAL RESULTS OF DIVERGENT STRABISMUS

Frank Martin F.R.A.C.O., F.R.A.C.S. and Jane Pardey D.O.B.A.
Sydney Eye Hospital

Abstract
The charts of 721 patients who underwent surgery for divergent strabismus at the Sydney Eye Hospital between 1937 and 1978 have been reviewed.

It was found that there was a marked preponderance of female patients in those with intermittent divergent strabismus (2:1). The onset of primary divergent strabismus was at an early age, 66% being reported as being present in the first five years of life. However there was a definite delay from onset till time of initial consultation. Patients with intermittent divergent strabismus tended to have surgery at an earlier age than those with constant divergent strabismus.

Surgical results were satisfactory after the initial operation in 63.85%. There was a significant over-correction in 8.45% and an under-correction in 27.7%.

Various factors that could influence the surgical result of divergent strabismus were considered and only the type of surgical procedure and the magnitude of the strabismus have a definite influence. Sex distribution, age at onset, visual acuity and refractive error, pre-operative orthoptics, treatment, retinal correspondence and presence of a vertical deviation which occurred in 42.5% have no influence.

Binocular function and near point of convergence could have a possible influence in the surgical results.

The authors acknowledge the assistance of the Orthoptic Clinic, Sydney Eye Hospital.

DISORDERS OF OCULAR MOTILITY IN PATIENTS WITH SPINA BIFIDA

Vivienne Gordon D.O.B.A. and Linda McKenzie D.O.B.A.
Lincoln Institute of Health Sciences

Abstract
This paper describes an on-going series of one hundred and one cases of spina bifida with an age range of one month to thirty-one years who were examined to determine the incidence and type of eye movement disorders present and to evaluate these results in terms of management. Results indicated a high incidence of eye movement disorders (74%) particularly in those cases with hydrocephalus. It was felt that there were advantages in early ocular assessment and that eye care should be part of a team approach to remediation.

EXPLORING THE SPATIAL AND TEMPORAL PARAMETERS OF STEREOPSIS

D. B. Dunlop F.R.A.C.O., R. A. Neill B.Sc. (Hons), and P. Dunlop D.B.O. (D.) (Lond.)

Abstract
The application of integrated electronics has allowed inexpensive investigation of temporal properties of stereopsis and the separate quantification of its global and central components.

A pilot study using a dynamic random stereotest yielded curves expressing stereopsis in terms of time and disparity. These revealed wide differences between groups with various binocular defects and a potentially useful sensitivity in differentiating apparently normal subjects.

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NOTES FOR CONTRIBUTORS

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Titles should be concise followed by the author's name, qualifications and institution or place where the work was conducted together with an address for communication.

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Notes on the preparation of scientific papers are available to intending contributors on request.

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