Overall 81% of the cerebral palsied children were found to have an ocular defect as opposed to 18% in the normal cross section.

Valium and Serepax are used in selected cases for muscle relaxation and a proportion of the children take anti-convulsants regularly. These tend to accentuate convergence insufficiencies and to reduce the control of heterophorias and squints.

Orthoptic treatments are those carried out in a normal clinic. There is occlusion for amblyopia, elimination of suppression and teaching of diplopia, convergence exercises, treatment for accommodative squints and so on, though treatment may be modified and unfortunately often has to be minimised.

A test is often done with the help of the teacher, speech therapist or psychologist to obtain the maximum response and this is especially valuable in visual acuity assessment. Comments on the visual acuity, the effect of a particular defect and, when necessary, the position or direction of greatest ocular comfort and best vision are made in reports available to the doctors, the school and the various therapies.

Over the past eighteen months, I have become increasingly aware of the part orthoptics can play in the assessment of potential and in the management of the cerebral palsied child and to say that the work there is rewarding would be quite an understatement.

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THE ORTHOPTIST'S CONTRIBUTION TO THE MULTI-DISCIPLINARY GROUP CONCERNED WITH LEARNING DIFFICULTIES

Patricia Dunlop

Presented in Sydney, April 1975

The term "learning difficulty" includes a wide range of conditions varying from obvious brain damage to classical dyslexia where intelligence is normal or even supernormal.

Until recently, the world of ophthalmology was curiously unable to offer any substantial help to those who sought to elucidate dyslexia, literally "difficult reading" which must, so obviously have an important visual element. There seemed to be no relation between eye functions and the tendency to reverse letters or small groups of letters, with omissions and multiple errors of sequencing.

However the recent discovery of a central pool of neurones in the visual cortex which respond only weakly or not at all to monocular stimuli, but respond vigorously to binocular input (Joshua and Bishop 1970), emphasised the need for detailed binocular investigations in place of the former emphasis on exclusively monocular visual acuity tests, simple muscle balance tests and monocular tests of ocular dominance.

This should be the home field of the orthoptist. It proved a fruitful field when we realised that it was important to look most critically at the very central binocular region of overlap, a few degrees wide, where both eyes are represented in each half of the visual binocular cortex. (Bishop & Henry, 1971; Stone, Leicester & Sherman, 1973)

The orthoptist can now demonstrate that in this central field of binocular overlap, dyslexic patients often show no preference, a variable preference or a preference which conflicts with the established dominance of speech and manual motor functions.

Here we have a visual factor which can be correlated with the other disturbed dominance factors, long accepted as an important characteristic of dyslexia. So far, it is only the orthoptist who can demonstrate this factor. She has a critical role in the documentation of all binocular and some non-binocular cases of learning difficulty.

Orthoptists have received limited acceptance at a few centres for investigation of learning difficulties around the world, particularly in the United States. Ward (1970), Hurtt (1971), Kambara (1971).

The special clinic at Broken Hill where Miss Peoples works, is a pioneer in Australia.

It is important to realise that the orthoptist's role is limited to ocular factors - she can have no part in the difficult parallel task of assessing relative intellectual potential or in the detailed analysis of writing and reading abnormalities. The psychologists and special remedial teachers have had many years of training to become competent in these fields. Hence the need for a multi-disciplinary team of which the orthoptist should become a natural member, just as in the past she has worked with ophthalmologists, neurologists and paediatricians. She must work also with psychiatrists, audiologists, speech pathologists, social workers, remedial and regular teachers. She should not forget her important role in communicating with parents who may be just as disturbed as the child. Of course, she may not meet with all members of such a team at once. But even if she only communicates by telephone or letter she should understand what is required and be prepared to undertake purposeful investigation and treatment.

When the patients come to the orthoptist, certain information will be available through earlier investigations. The child will have been assessed medically and educationally. There should be some estimate of his intelligence and performance and some notes as to whether the problem appears to be essentially visual, auditory, emotional or due to some lack of motor co-ordination, or combinations of these factors. The medical history will give the orthoptist some idea whether she is dealing with a normal child or not. The ophthalmologist will have assessed the state of the child's eyes and prescribed glasses where necessary. Speech and auditory tests may have been done.

Very often the child will be a normal, active (perhaps hyperactive) intelligent child, with no refractive error and no apparent ocular muscle imbalance. Parental and teacher's comments on the child's reading, writing, spelling and maths are helpful and the incidence of reversals, inversions, place holding whilst reading, misreading or skipping words, blurring, diplopia, head tilting and headaches should also be noted. Inquiry into family history of learning difficulty, left handedness and ambi-dexterity should also be made, and any stress situation, particularly during the early years of schooling will also help in the understanding of the child's problem. Attention should be given to the child's handedness and history of how it has developed, taking into account any injuries to fingers, hands and arms. Head injuries and birth complications will be noted from the medical history. All these factors are relevant in relation to the child's present age and performance.

Orthoptic Examination should include cover test; ocular movements; visual acuity; convergence and accommodation; muscle balance for near and distance - either Maddox rod and wing or prism cover test; full detailed assessment of binocular vision including the angle of deviation and fixation of either eye; subjective tests of fusion and fusional reserve; stereopsis and stereo-acuity; suppression should be noted and reference eye

in the central binocular field recorded. Sighting eye (monocular test) may be noted for historical interest - this does not necessarily correspond with the reference eye.

The Reference Eye Test has been described (Dunlop, 1974) but discussion of the responses to the test may be helpful. The first essential is to determine whether useful binocular single vision exists in the central binocular field of 2^{o} ... 3^{o} around the point of bifoveal fixation. Where binocular single vision is present responses may be - a) R reference, b) L reference, c) alternating reference, d) lack of development of reference.

Where suppression of binocular vision is marked in some squints, anisometropia or amblyopia, there is no real binocular vision in the central overlapped field and thus no visual confusion of laterality can occur.

For example, one sometimes sees a child with anisometropia and amblyopia of a line or two in the eye corresponding to the preferred hand, coping well with reading and school work, because in such a case the reference eye mechanism can not exist and no such confusion of visual perception is possible. (Of course confusion of laterality of speech, auditory and motor functions could still be present.)

In the classic case of visual dyslexia, suppression is very rarely a problem and the child can appreciate physiological diplopia very easily. This is an interesting finding because these children often have trouble with figure ground work, where they have to pick out certain specific shapes from a complex drawing of many shapes. They have difficulty in suppressing the irrelevant background.

The reference eye assessment should be correlated with the existing handedness of the child so that the relation of the visual function to the manual laterality of the child may be classified as–

a) normal correspondence,
b) crossed correspondence
c) alternating correspondence
d) undeveloped correspondence

Following full orthoptic investigation and diagnosis the orthoptist is in a position to offer treatment in an effort to promote normal binocular functioning. This will include treatment for defects of –

a) visual acuity such as amblyopia and suppression,
b) ocular muscle balance and convergence and
c) treatment to promote the desired corresponding reference eye in the central binocular field. a) and b) are normal parts of orthoptic therapy but c) is a a new area for orthoptists and treatment is experimental at present.

Some centres in New South Wales are experimenting with total occlusion of the opposite eye to the desired reference eye during all close work and sometimes for TV also. This is supported by convergence training in the form of home exercises. It is necessary to keep convergence active because of the considerable periods of monocular activity for close work; convergence training is also necessary because these children characteristically show poorly maintained convergence. No case of amblyopia has yet occurred in spite of occlusion extending up to 18 months, during experimental work over three years.

This type of treatment has been successful in many cases. The children begin to respond after several months on the occlusion routine. Generally, writing begins to improve first, reversals tend to disappear and later reading begins to improve. Spelling appears to take longest to improve.

However, not all cases respond to this type of therapy. Even 12 - 18 months occlusion may not alter the side of the reference eye. In such cases parents and teachers have said that the child has improved but is still functioning below a desirable level. These cases seem to be quite resistant to our efforts just as do some cases of squint who fail to develop binocularity. It is probable that confusion of laterality in other modalities perpetuates their sequencing difficulties.

Orthoptic treatment is still experimental, and will take some years to fully assess in controlled studies.

The following analysis of 345 cases currently undergoing orthoptic treatment is not a pre-planned study, but a review of a fortuitous group of my patients with a common problem.

TABLE I

ANALYSIS OF 345 CASES CURRENTLY UNDERGOING ORTHOPTIC TREATMENT

DIAGNOSIS	MALES	FEMALES	TOTAL	
Crossed and unstable correspondence	201	49	250	
Lack of and undeveloped correspondence	40	11	51	
Convergence insufficiency with normal correspondence	31	3	34	
Intermittent deviation				
Convergent	4	1	5	
Divergent	2	1	3	10
S.O.T.S.S.	2		2	
	280	65	345	

Table I shows the distribution of various groups. **Crossed correspondence** (reference eye opposite to preferred hand) and unstable correspondence are grouped together and form the largest group, as they appear to have similar problems with reversals, reading and spelling. **Lack of reference and undeveloped reference** form another group where the patient gives no indication of lateralisation of visual function. When this persists (beyond the age of about six years) he often has poor spatial orientation and difficulty with lateralisation in reading and writing. **Convergence insufficiency** with normal correspondence forms quite a small group. These children rarely have any trouble with reversals, but misread, lose the place and lack concentration; they respond well to conventional orthoptic training in a relatively short time. **Intermittent deviation** forms another small group with a fairly even distribution of convergent to divergent deviations. It is interesting to note two cases of Brown's superior oblique tendon sheath syndrome in this group. There were no cases of constant strabismus. Half of the group with intermittent strabismus required surgery and subsequently responded well to treatment.

TABLE II

HANDEDNESS

	MALES	FEMALES
Right handed	235	51
Left handed	41	14
Ambidextrous	4	0
Total	280	65

$\chi^2 = 1.944$, df = 1. Not significant

Table II shows the distribution of handedness by sex. Despite an apparent tendency toward sex differences in incidence of left-handedness in this group, the difference in incidence between males and females is statistically not significant.

TABLE III
TREATMENT

	MALES (280)	FEMALES (65)	TOTAL (345)
Glasses Prescribed	24	0	24
Convergence Training	280	64	344
Occlusion	252	60	312
Operation			
(con.)	2	1	5
(div.)	1	1	
Change of Hand	3	0	3

TABLE IV

REPORTED RESULTS

	MALES (280)		FEMALES (65)		TOTAL (345)
		%		%	
Fewer Reversals	265	(94.6)	59	(90.8)	324
Neater Writing	241	(86.1)	60	(92.3)	301
Better Reading	224	(80)	52	(80)	276
Improved Spelling	147	(52.5)	36	(55.4)	183

Table III shows how few children required refractive help although it is a real advantage to have even a small cylinder prescribed if necessary for the desired reference eye. Convergence training played a very important role in conjunction with occlusion in the treatment regime of most of the children. Convergence training by the usual daily home exercises has proved satisfactory. Occlusion is only used for close work at school and at home. (The eye opposite to the desired reference eye is occluded.) Total occlusion seems to work better than opaque transparencies, either on elastic around the head or on spectacle frames. Atropine occlusion was not used on any of these cases, but is being used as a trial in another group. Atropine has the disadvantage of lasting some ten days after instillation before it is possible to carry out a reasonably accurate test for reference eye even for a check up procedure; while the effects are present it masks the test.

Where surgery for an intermittent deviation was performed the response to subsequent orthoptic treatment was good.

Only three children made a change of hand for writing with favourable results in each case. This change was only undertaken after careful consideration by all involved members of the multi-disciplinary team.

Two boys in the crossed correspondence group had suffered broken arms during the pre-school period and had changed handedness of necessity. Neither of these children responded to occlusion therapy and the reference eye did not change over in 18 months. Learning was still a problem for them.

A number of young children had not established a dominant hand and in most, the reference eye was undeveloped also. Where the reference eye was established the hand was encouraged on that side. Otherwise it seems best to wait until more definite lateralisation is apparent, at least in the younger child. In the older child occlusion can be used to promote the desired dominance, again in consultation with other members of the team in deciding which hand is to be encouraged. New procedures to establish the side of the speech centre may be of great value in this type of case. Low (1973) , Fenelon.

Table IV - Results of treatment for this group have been assessed from comments by teachers, parents, school counsellors and psychologists. Ideally all the children should have had educational assessments before and after treatment but this was not possible for various reasons in this unplanned group.

Fewer reversals were reported in a high percentage of the cases and this seemed to relate to co-operation and diligence in wearing the patch. Neater writing also occurred in high percentage and seemed to coincide with better co-ordination generally; the children seemed to be less clumsy. Reading was said to have improved, and many mothers reported a better attitude toward books and school work. Spelling was the slowest to improve and many children still had trouble even after eighteen months training.

The most pleasing outcome of treatment was the happier outlook of the children both at school and at home. The children seemed to be more relaxed and co-operative than before.

TABLE V

LENGTH OF TREATMENT

	NO. OF CASES
6 months	158
12 months	99
18 months	88
	345

Length of Treatment - 158 of the cases here reported have been under treatment for at least 6 months., 99 for 12 months, and 88 for 18 months. Treatment seems to take about a year to complete; if the reference eye has not changed in that time, it is dubious whether it ever will with further occlusion. In some cases it may be necessary to allow a child with an apparent crossed correspondence to maintain a small suppression area with persistent poor convergence, i.e. monocularity in the central overlapped field.

The orthoptist has a responsibility to fully assess all cases of learning difficulty referred to her and to communicate adequately with other members of the team. In this way a careful selection of cases suitable for orthoptic training may be given treatment, while useless and unwarranted intereference may be avoided.

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DEVELOPMENT OF VISUAL ACUITY

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Has anything new been discovered about the actual visual acuity of the infant? It was decided to find out what has been written recently on this subject.

The optokinetic drum has been used to produce nystagmus to evaluate vision. Optokinetic nystagmus is a visuo-motor reflex which can be elicited in normal circumstances at an even earlier age than the light fixation and following reflexes. However, until very recently an accurately graded drum could not be bought. To quantify the response it is necessary to have the black and white stripes so graded as to be equivalent to the Snellen's test chart. It is also important that the drum should rotate at a given speed.

Now two ophthalmologists have improved this instrument. Their version has six circular targets, of values equivalent to Snellen type. A motor rotates the drum. It is held 60cms from the baby and is a quick and easy test to assess visual acuity. Using their improved drum, Catford and Oliver (1973) did a survey on adults whose vision was known. The drum proved very accurate. Encouraged by this they did a survey of children under the age of one year. They found that babies fixate from two weeks of age, but optokinetic nystagmus could not be induced until six weeks. Acuity increases to 6/18 at five months, to 6/12 at 18 months, to 6/9 at two years and to 6/6 at three years.

Thus they have proved that the infant sees better than other authorities believed. Many of our text books state that vision is much lower in babies under one year. Their estimates were based on deduction. The work of Catford and Oliver has proved the better vision objectively.

It is interesting to realise that a three year old child already has normal adult vision for distance and near. The ciliary muscle is fully developed at this age and so the child is capable of good, prolonged accommodation.

Perhaps therefore we should not insist that toys and picture books should be large. The only reason to give a learner large print to read is that it enables him to consider a few letters at a time. a question of comprehension rather than vision.

Other authors including Ruskell (1967) agree that there is a high level of visual acuity at birth. Yet in the general literature it is stated that the fovea and macula are