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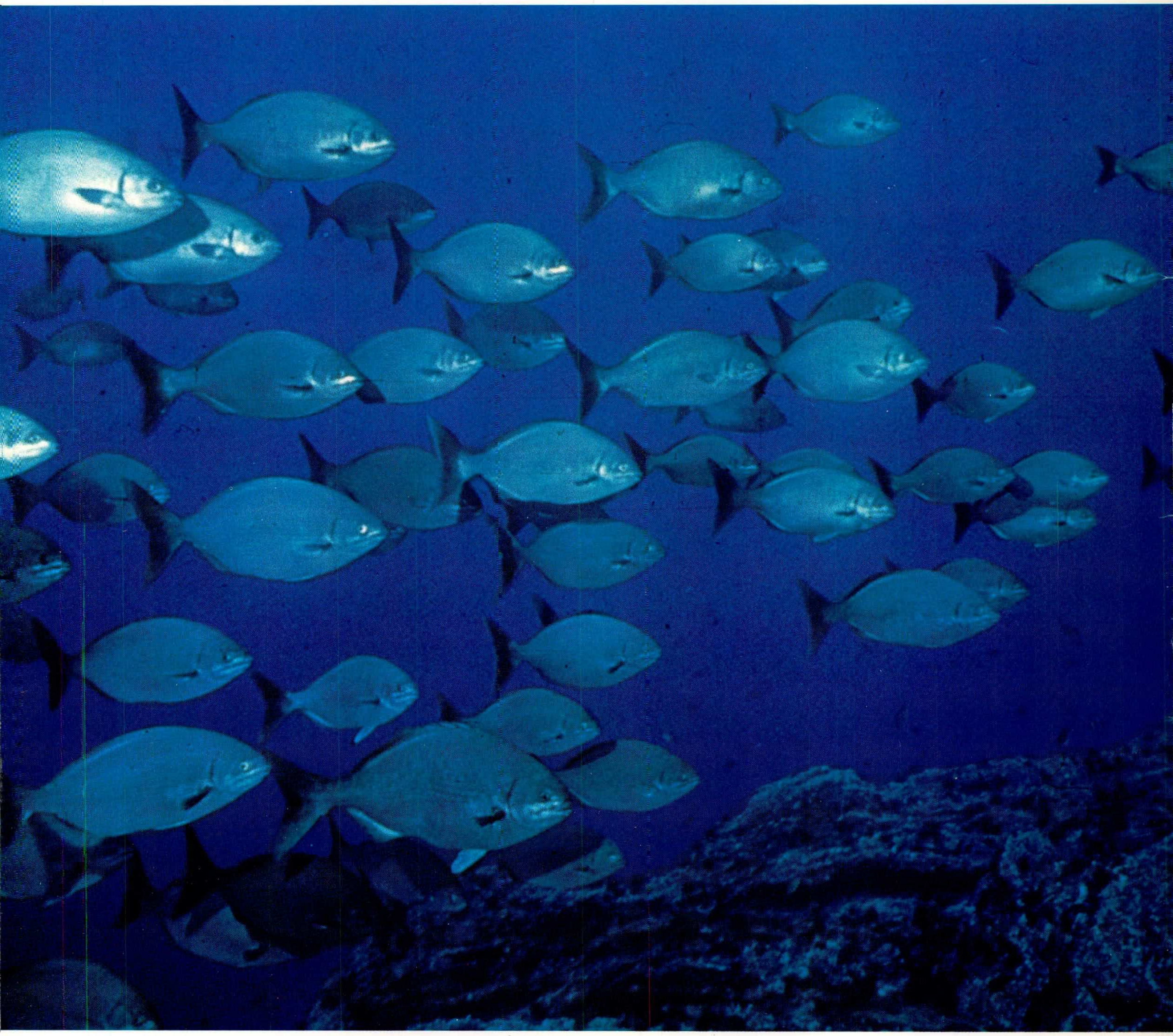

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1. Gorn, R., Opthalmology Times p. 1 March/81
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In this Issue

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EDITORIAL

A Conflict of Interest: Medicine's Double Standard

"People who live in glass houses should not be casting stones." So goes the old proverb and most people would accept it and conform to it. However, ophthalmology and Medicine have recently resurrected, with their "customary wisdom", the old red herring cliché of "conflict of interest" because a number, if not most optometrists carry out the dispensing of their own prescriptions. The statement implies that optometrists dispense glasses unnecessarily in order to augment their income; in short, they are accusing optometrists of fraud and dishonesty.

It should be pointed out that if ophthalmology has evidence of any wrongdoing, there are proper legal channels through Colleges & Boards of Examiners to bring this to optometry's attention. This profession is anxious to uphold the highest levels of practice.

But is it not strange that physicians who carry out *their* own therapeutic recommendations on *their* own patients are not guilty of *any* conflict of interest and that they are thoroughly ethical in all their decisions? At least, so say the Canadian Ophthalmological Society and the Canadian Medical Association.

How should one describe the actions of the ophthalmologist who dispenses contact lenses to his own patients, a practice which has grown impressively since the advent of soft contact lenses? Why the double standard of condemning the optometrist and exonerating the ophthalmologist for *exactly* similar practices?

But there is a situation in medical practice which is far more prone to be a source of "conflict of interest" because it produces a far more impressive fee for the physician than any fee derived by an optometrist for dispensing a pair of contact lenses or spectacles.

How does one describe the actions of the physician who, after proper examination, recommends surgery and performs that surgery himself? Has not this a far greater potential for being labelled "conflict of interest" than the situation of the optometrist because of the high fees usually demanded for surgery?

If medicine is sincere in its accusations about optometrists, then medicine should *immediately* create a new, exclusively surgical, paramedical group and no physician should be permitted to carry out surgery himself on his own patients. Dr. Clement McCullough calls surgery, "the cutting trade." A *trade* does not require an M.D. degree, but only a steady pair of hands and an above-average knowledge of human anatomy. The Russians have already instituted a para-medical surgeon. Are we going to permit the Russians to outstrip us in this area of health care?

If optometry, to be ethical, must surrender its dispensing aspects of practice to the dispensing optician, then medicine should surrender surgery to a para-medical assistant. What is sauce for the goose is sauce for the gander!

That conflicts of interest do exist in several medical specialties is attested to by physicians themselves as the following reports reveal. Dr. Christaan Barnard, of heart transplant fame, says: "Coronary bypass, misused"[2] Dr. Howard Seidin, syndicated medical columnist in the now-defunct Today Magazine stated that surgeons grow rich on surgery and condemns the abuses.[3] Dr. W. Gifford-Jones, another syndicated medical writer says "Many radiologists have a conflict of interest. The more films they take, the greater their income"[4]. But, apart from this conflict of interest, have the physicians the right to expose their patients to unnecessary radiation hazards?

Potential conflicts of interest; one can locate them in *any* human activity, trade or liberal profession but most are *not* sufficient reason to condemn all members of those callings and to make public libellous statements in order to attract more people to one's office. People who live in glass houses should not be so imprudent as to cast stones.

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G.M.B.

GUEST EDITORIAL

Vision Care for Children

Pediatric optometry, developmental vision care, or vision care for those children with learning disabilities, requires patience and, at times, ingenuity on the part of the optometrist. It can be said that, given the care of a child, the optometrist can cause him or her to develop any direction visually, and possibly emotionally. Despite the demands on the optometrist, the satisfaction for the practitioner is most rewarding.

As the child develops his/her visual skills, (s)he enhances his/her opportunities to learn in school, to take part in sports, and, indeed, to become a well-rounded individual fitting into the environment of his/her peers. With this in mind, 20/20 (or 6/6) visual acuity in itself means but little. The means by which it is achieved, maintained and utilized is the essential factor in the determination of how the child will react to the presentation of visual tasks at distance and at near.

Much has been written, and many have lectured on the subject. If you, the reader, have not been convinced by the vast amount of material available in the past, there is little to be gained in your perusal of this presentation. The question of whether small amounts of plus correction, convergence deficiencies and uncontrolled ocular movements alone or in combination, can be counter-productive to achievement in play and, subsequently, in the formal education system, has been answered countless times by optometric practitioners.

The visual assessment of a child cannot be conducted in the same manner one utilizes for adults. The case history must include elements of the child's birth and, in some special cases, e.g. Down's Syndrome, cerebral palsy, etc., pre-natal conditions and development. As the child becomes older, questions regarding play habits and co-ordination are in order: can the child colour pictures; how does (s)he conduct him/herself in so doing and does he or she manage to stay within the confines of the picture? Ask the child which hand he or she is using; if (s)he doesn't know right from left, look for the possibility that a laterality problem may arise when letters are reversed and shoes placed on the wrong feet. Can the child catch a ball bounced directly to him/her? If he or she is old enough to do so, but cannot, there may be a convergence or depth perception problem. Cover testing and the stereoscopic fly or deer will help to reveal such deficiencies. Binocular vision testing, saccadic eye movements and pursuit movements must be assessed also.

Impairment in visual skills can result in poor visual efficiency affecting performance in scholastic achievement and, in the younger child, can reveal one who is at risk for the future. Combined with even a small hyperopic refractive error, this frequently produces a stressful situation that, more often than not, is more than the child can cope with. Despite a visual acuity of 20/20 (6/6), a careful retinoscopic examination is not only required, but demanded. Frequently, practitioners fail to go the essential step farther and perform "book retinoscopy". The active participation of the young patient will do much to reveal the need for plus in a dynamic situation. (In a younger child, the use of a toy target at 12 inches, while the child describes it, will produce similar results).

Many will question "the scientific proof" that small amounts of plus produce worthwhile effects, and this practitioner has no graphs, efficiency quotients, etc. Hundreds of clinical cases are available in offices where pediatric optometry is practised which attest to the efficacy of plus therapy in small degrees. If you, as a vision care practitioner, are truly interested in the long-term welfare of your young patients, it is incumbent upon you to acquaint yourself with the techniques described and to utilize them.

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PEDIATRIC VISION

Psychogenically Induced Hypertonicity of the Ciliary Muscle

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J.G. Strong**

Abstract

Greatly reduced visual acuity in children in the absence of any obvious pathology or significant refractive error is frequently attributed to malingering or hysteria. We report here routine office procedures and electrodiagnostic tests that were used to detect an exceptionally large, long-term, emotionally-based accommodative spasm that caused a profound loss of visual acuity but no other symptoms typically associated with accommodative disorders. The simple therapy that rapidly restored normal visual acuity and relieved an electrophysiologically determined binocular dysfunction is discussed.

Abrégé

Une diminution significative de la vision dans l'absence de pathologie ou d'une réfraction marquée est souvent attribuée à une condition d'hystérie ou à une simulation de la part du patient. Ce travail discute des tests routiniers et des tests électrophysiologiques qui ont servi à déceler un profond spasme d'accommodation de longue durée et à base émotive chez une jeune fille manifestant une baisse importante d'acuité mais sans aucun autre symptôme relié à un désordre d'accommodation. Les auteurs traitent d'un programme de réhabilitation simplifié qui a restoré rapidement l'acuité et corrigé un désordre de binocularité mis à jour par les tests électro-physiologiques.

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An intelligent, eleven-year old girl (CK) was referred to the Electrodiagnostic Clinic at the University of Waterloo (Ontario, Canada) School of Optometry because of severely reduced visual acuity in each eye (about 20/1600, OU). The patient reported that a reduction in visual resolution was first noticed about one year ago, but was not associated with any physical trauma or systemic disorder. An eye examination performed two years earlier by another ophthalmic practitioner did not reveal any abnormalities or a need for glasses. The patient was in good health, but was taking nasal and ocular decongestants (2% Na chromoglycate) for allergies to grass, trees, weeds etc.) CK denied any useful form vision for distant objects and had to use her teacher's notebook because of an expressed inability to see large print on the blackboard even from the front row of seats in the classroom. The patient's nearpoint vision was satisfactory when the reading material was held nine to ten centimeters from her facial plane. According to the patient's mother, CK had always had good vision and had always been an avid reader. Within the last year, however, her interest in reading had declined significantly.

In a routine oculo-visual assessment the patient had demonstrated inconsistent monocular visual acuities, and binocular visual acuities that were occasionally worse than monocular acuities. Application of an optical correction for an apparently high amount of myopia (about 5 Diopters) had not improved the visual acuity. However, some improvement in visual resolution was noted when visual acuities were taken through pinholes. The referring clinician requested an electrodiagnostic examination of this patient to determine whether the large reduction in visual resolution was caused by a subclinical lesion in the visual pathways or whether the patient was malingering. A prognosis for recovery of normal vision was also requested.

Clinical Findings

The following observations were made on the patient's first visit to the electrodiagnostic clinic.

Visual Acuity

6m	0.10m	present Rx
OD 6/240 (20/800)	0.37	none
OS 6/240 (20/800)	0.37	none
OU 6/240 (20/800)	0.37	none

Estimates of distance visual acuities were very difficult to obtain but considerably better than stated by the referral source. Nearpoint acuities were obtained quite readily when a reduced Snellen acuity chart was held about 10 cms from the facial plane.

Binocularity

The patient demonstrated conjugated eye movements in response to a penlight target moved into all cardinal positions of gaze. Assessment of the binocular status by the Hirschberg corneal light reflex technique revealed a non-strabismic condition. Simultaneous binocular vision was indicated by a normal response to the Worth 4 dot test performed in darkness at an observation distance of about 25 cms. The standard cover tests for detection of latent or manifest ocular deviations, and measurements of stereo acuity were not possible because of the great reduction in central vision.

Ocular Health

Examination of the ocular tissues and adnexa did not disclose any abnormalities. The pupils of both eyes were distinctively large, about 4mm, but exhibited normal direct and consensual pupillary light reflexes and a negative Marcus-Gunn test. Ophthalmoscopic examination of the ocular media and fundi did not reveal any clinically significant abnormalities. A sharp foveal reflex was seen in each eye, and macular areas, although slightly mottled, were judged to be normal.

Refraction

Static retinoscopy and subjective refraction revealed the following:

Static	Subjective	Best VA
OD -8.00DS	-8.00DS	6/15 (20/50)
OS -6.25DS	-6.25DS	6/15 (20/50)

Whereas the neutral point for the right eye was easily determined, the exact neutral point for the left eye was somewhat uncertain because of instability of the retinoscopic reflex. Increasing or decreasing the correction for myopia by two diopters or more did not significantly change the patient's continued reports of poor vision.

Electrodiagnostic Evaluation

Gross cone function was assessed by flicker visual evoked responses[1,2] (VER's). In this test the functional integrity of macular cortical pathways is assessed by measuring the ability of visual pathways to transmit temporally modulated diffuse light flashes delivered to each eye within a ganzfeld[3] stimulator to visual cortical areas. Under photopic conditions, flash frequencies of about 30Hz or more elicit responses exclusively from cones. Eliciting a normal flicker VER is an indication that the cone system is functioning normally at a gross level. In this patient's case sinusoidally shaped VER's with peaks occuring at a frequency determined by the rate of flash presentation were obtained for 30Hz and 50Hz stimuli (Figure 1). Therefore a gross cone dysfunction was not indicated for either eye and a profound loss of visual acuity was not expected.

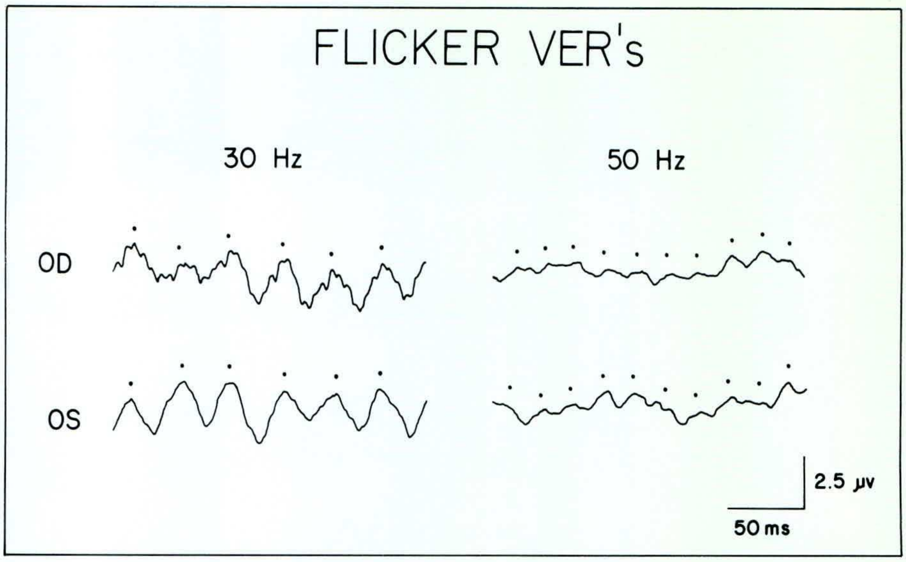

Fig. 1 Flicker (non-pattern) VER's elicited by diffuse white light flashes delivered to each eye within a ganzfeld stimulator at 30 Hz and 50 Hz. Each trace represents the average of 50, 200 ms responses. Note that each flash (indicated by a black dot over the VER records) is associated with a peak in the VER. These records indicated a grossly normal photopic system.

The integrity of the pattern processing mechanisms for each eye was assessed by steady-state pattern VER's.[1,2] This type of VER is elicited by a checkerboard target composed of black and white checks that rhythmically reverse from black to white to black at a pre-set frequency. The VER waveform elicited by such a stimulus approximates a sinusoid whose frequency is determined by the checkerboard reversal rate.

Under monocular and binocular viewing conditions a distinctively sinusoidal VER waveform could be obtained repeatedly only when the check size within the six degree checkerboard target was increased from the standard size of 14 minutes of arc to 112 minutes of arc (Figure 2). This observation indicated that the pattern processing mechanism was functional but required larger-sized targets for optimal operation.

A diagnosis of bilateral foveal dysfunction but normal macular function was possible after the recordings shown in Figure 2 were made. However, there were two observations that made such a diagnosis unlikely. First, a detailed examination of the periodicity and waveform of the VER's elicited by 14, 28 and 56 minutes of arc checks (Figure 2) revealed distinguishable but poorly formed sinusoidal waveforms for each check size. A lesion restricted to foveal areas would ordinarily cause an essentially flat VER for the smaller check sizes. The poorly formed VER's recorded for the smaller sized checks were more typical of VER's elicited by optically degraded checkerboard stimuli. Furthermore, even though the averaged VER's were somewhat degraded, individual VER's were often seen to be regular in waveform. Secondly, there was a large discrepancy between the visual acuity predicted by the pattern VER and that obtained subjectively. Based on many previous clinical observations, a good VER recorded with a checkerboard composed of 14 minutes of arc checks suggests a visual acuity of at least 6/6 (20/20). Inferior visual acuity is indicated if the checkerboard check size must be increased to obtain a regular VER pattern. Inasmuch as

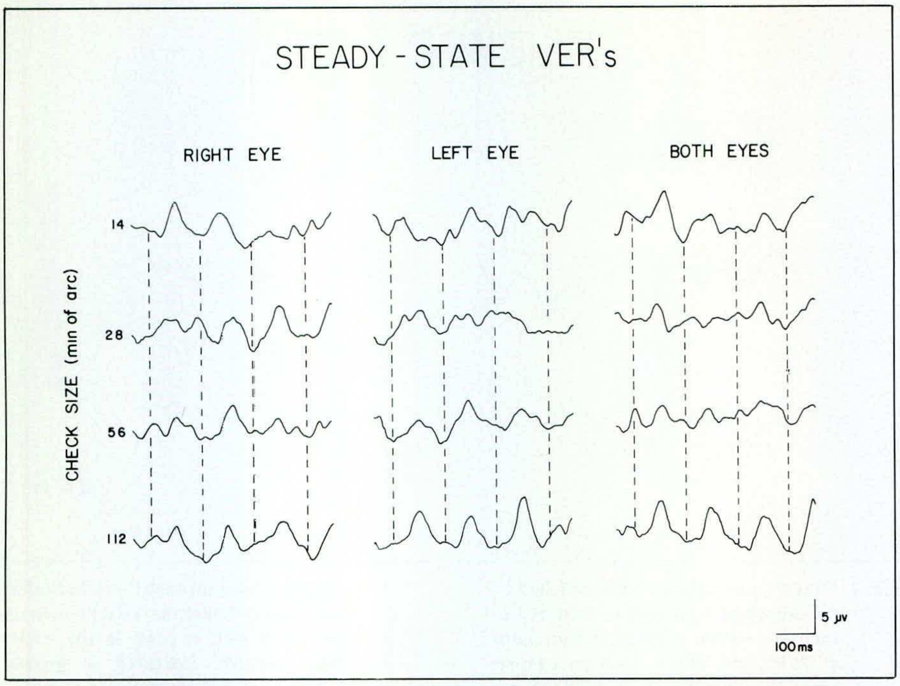

Fig. 2 Steady-state VER's elicited under monocular and binocular viewing conditions by a 6⁰ checkerboard target with 14, 28, 56 and 112 minutes of arc black and white checks reversed at a rate of 8.25 Hz. Each trace is the average of 50, 500 ms responses. In this test condition the patient viewed the checkerboard target without glasses. Note that while a recognizable VER pattern was elicited by each check size, only the largest check size produced a distinct sinusoidal waveform. This observation indicated bilaterally reduced visual acuity.

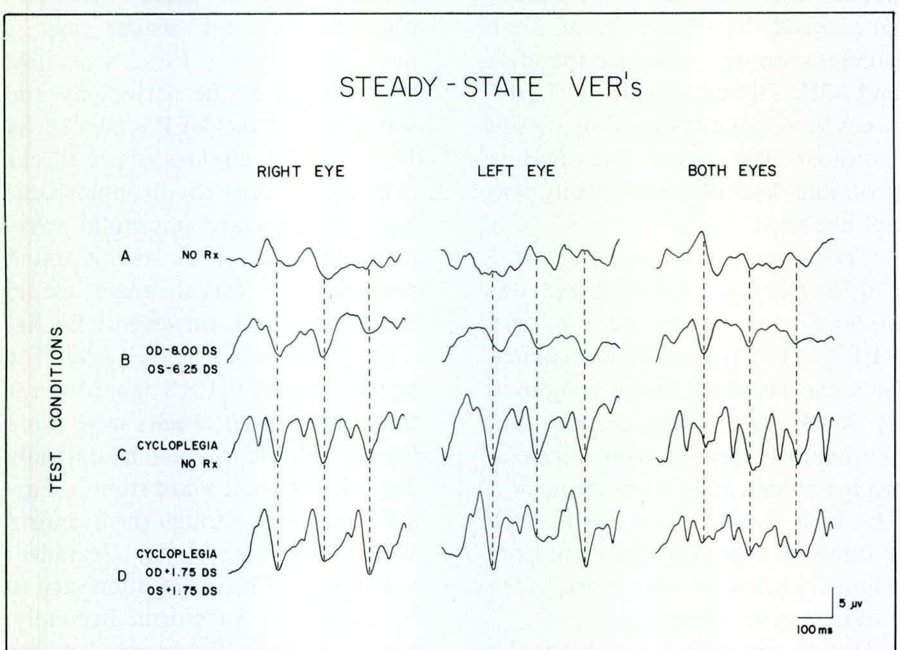

Fig. 3 Steady-state VER's elicited from each eye and both eyes by a 6⁰ checkerboard with 14 minutes of arc black and white checks reversed at 8.25 Hz. Each trace is the average of 50, 500 ms responses. The VER records were obtained under four test conditions: A. No glasses worn by the patient; VER is irregular. B. Patient wearing a correction for the myopia determined by retinoscopy. Note the clear improvement in the VER waveform and amplitude. C. Experimental cycloplegia; when compared to condition A or B, a very distinct improvement in the VER is seen for each eye. The binocular VER, although still recognizable, is somewhat irregular. D. Experimental cycloplegia with a correction for the hyperopia measured by retinoscopy. Note the further enhancement of the monocular VER's but the continued degradation of the binocular VER. This latter observation indicates a binocular anomaly.

our patient's best VER was obtained with a checkerboard target made up of checks eight times the standard check size, it was predicted that this patient should have a visual acuity of roughly 6/48 (20/160) or better. Since the patient reported visual acuities much worse than 20/160, possible diagnoses of malingering or functional amblyopia remained.

A very significant improvement in the VER waveform and amplitude was obtained when the VER was repeated with a correction for the apparent myopia as indicated by retinoscopy (Figure 3, test condition B). This observation clearly indicated, by entirely objective means, that the afferent neural signal for pattern resolution could be improved to a near normal state apparently by a correction for a simple myopic condition. A myopic refractive status was also suggested by the patient's report of an improvement in visual acuity when a correction for myopia was applied. Inasmuch as the VA was still reduced and notably unstable (6/15 or 20/50 OU) even with the myopic correction, one might have concluded a residual amblyopia after optical correction of a previously uncorrected myopia. However, the previous observations of variable monocular and binocular visual acuity measurements, fluctuation in the retinoscopic reflex for the left eye, and variable VER's for specific test conditions prompted further investigation of the refractive status by an experimental cycloplegic refraction.

The VER's obtained for each eye under cycloplegia are shown in Figure 3, Test condition C. With the ciliary muscle temporarily paralyzed, the VER's elicited for each eye by a checkerboard target composed of standard check sizes (14 minutes of arc) were regular in waveform and of good amplitude. The binocular VER, however, was degraded indicating a non-specific binocular dysfunction. As the binocular VER without cycloplegia was regular in waveform, the disturbance in the binocular VER under cycloplegia was attributed to the well-known effect of cycloplegics on the AC/A ratios[4] and consequent effects on binocular co-ordination. The observation that enhanced VER's were obtainable under cycloplegia indicated clearly that the myopia detected by retinoscopy was caused by a persistent, large amplitude ciliary muscle spasm. Retinoscopy performed under cycloplegia revealed a bilateral hyperopic condition requiring about +1.75DS for neutralization. The VER's elicited from each eye with cycloplegia and a correction for the hyperopia are shown in Figure 3, test condition D. It is readily apparent that a further improvement in the VER waveform and amplitude was obtained when the value of the refractive error detected under cycloplegia was neutralized. (NOTE that the binocular VER was still irregular in waveform). This observation strongly suggested that the refractive status of both eyes was near optimal and that no physiological impediment to normal visual function existed. Based on the observations noted above, a prediction of normal visual acuities was made even though the patient was apparently not impressed by the clarity of the checkerboard target. Subsequent subjective evaluation of visual resolution revealed a sluggish 6/6 (20/20) visual acuity level in each eye when the correction for hyperopia was worn. A great amount of encouragement and coaxing of the patient was required to elicit this maximal visual acuity.

Therapy

In the course of the examination and private conversations with the mother after the examination, it was learned that CK was a very sensitive and empathic child that had undergone several emotional upheavals within the last twelve to eighteen months. Most of the patient's previous emotional crises were related to sibling rivalry and strained maternal interactions. As a result of these revelations, a causal relationship between the patient's emotional disturbances and visual disorders was hypothesized.

Therapy, therefore, firstly consisted of counselling the parent to resolve any current emotional problems experienced by the patient, and strongly reassuring the patient that her vision could be improved, with her cooperation. Secondly, an attempt was made to eliminate the enormous ciliary muscle spasm revealed by the cycloplegia refraction. To minimize ciliary muscle activity the patient was instructed to wear stock +1.62DS, OU "loaner" glasses for all visual tasks starting immediately after the examination while the ciliary muscle was still immobilized by the cycloplegic agent. The patient was then scheduled for a reassessment in one week.

Re-Assessment

On the return visit one week later, the mother confirmed that the "loaner" glasses had been worn every day throughout the patient's waking hours and that there had been a considerable improvement in her child's emotional disposition since her first visit. The mother also enthusiastically reported that she "couldn't believe the difference" in her daughter who was now holding her reading material at a normal distance and no longer used her teacher's notebooks because she could see the letters printed on the blackboard even from the middle of the classroom.

An oculo-visual and electrodiagnostic re-assessment yielded the following information.

Visual Acuity

6m		0.4m	
Unaided	**Aided (+1.62 DS)**	**Unaided**	**Aided (+1.62 DS)**
OD 6/12 (20/40)	6/7.5 (20/25)	1.0	0.37
OS 6/12 (20/40)	6/7.5 (20/25)	1.0	0.37
OU 6/12+3 (20/40+3)	6/6 (20/20)	0.75	0.37

All visual acuity measurements were quantified easily without any significant hesitation by the patient. The only external sign of some visual stress was a prominent contraction of the corrugator superciliae muscles when unaided visual acuities were measured at 6m.

Binocularity

The results of the initial ocular motility examination were unchanged in the patient's second assessment of binocular function. However, because of the greatly improved visual acuity from the first visit an assessment of binocular function by the cover test, fusional vergence testing, and stereo acuity measurements was possible.

These tests revealed an orthophoric condition at 6m, 3 prism diopters of exophoria at 0.4m and normal horizontal and vertical, fusional reserves. The gradient AC/A was somewhat low at about 2/1 and the stereo threshold measured with the Titmus Stereofly was 40 seconds of arc.

Overall, no significant abnormalities in the patient's binocular vision were detected by standard tests of binocular function.

Ocular Health

No changes in the ocular tissues or macular areas were noted from the first examination.

Refraction

Static retinoscopy and subjective refraction (without cycloplegia) revealed the following:

Static	Subjective	Best VA
OD +0.75DS	+1.50DS	6/6 (20/20)
OS +0.75DS	+1.50DS	6/6 (20/20)
OU		6/4.5 (20/15)

Retinoscopy revealed continuous low amplitude (less than 1 D) low frequency fluctuations in the accommodative system that induced variations in ocular refraction ranging between low myopia to low hypero-

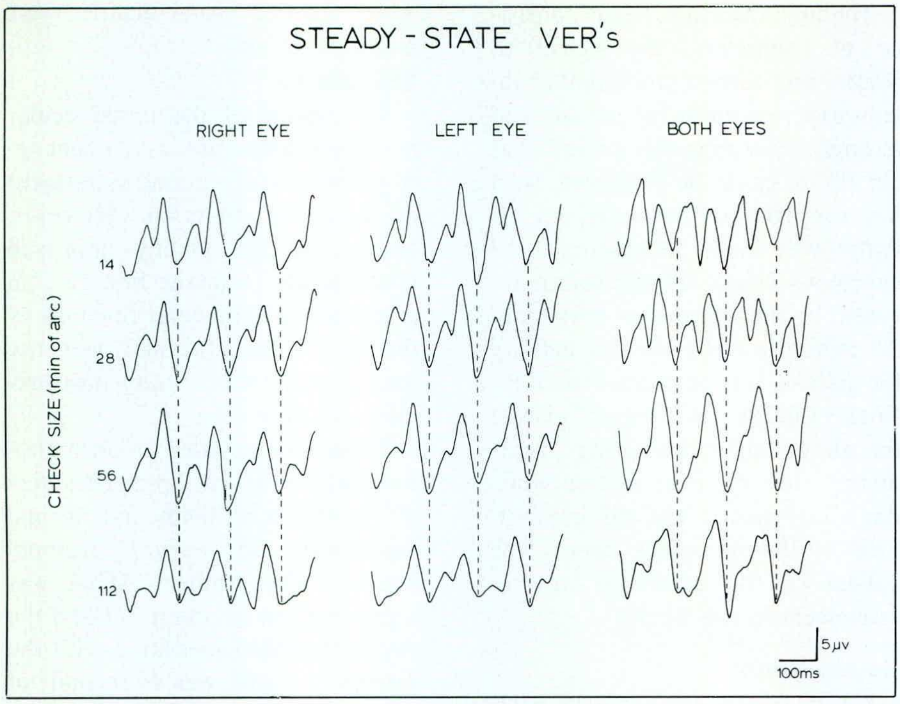

Fig. 4 Steady-state VER's elicited under the same conditions described for Figure 2, one week after the patient's initial visit. The patient wore +1.62 DS lenses for all visual tasks during that week. For the test condition shown in Figure 4 the patient did not wear glasses so the results are directly comparable to those shown in Figure 2. Note the greatly enhanced VER's elicited for each eye by all check sizes, including the standard check size of 14 minutes of arc. This observation suggested normal visual acuities for each eye. Note also that the binocular VER's were somewhat degraded for VER's elicited by the 14 and 28 minutes of arc check checkerboards, but normal when the checks were increased to 56 and 112 minutes of arc. This observation indicated a measurable level of binocular stress for attempted steady fixation of small objects.

pia. These accommodative fluctuations were gradually stabilized as plus lenses were added before each eye.

Electrodiagnostic Evaluation

Figure 4 presents the steady-state VER's obtained for monocular and binocular viewing conditions for checks of increasing size. (A correction for hyperopia was not worn during this test procedure). In strong contrast to the monocular VER's obtained for this patient one week earlier under identical stimulus conditions (Figure 2) a distinct sinusoidal waveform was obtained not only for the largest check size of 112 minutes of arc but also all check sizes down to the standard check size of 14 minutes of arc. This represented greatly enhanced responses from retino-cortical mechanisms processing pattern vision. However, the binocular VER's elicited by a checkerboard composed of 14 minutes of arc checks were characterized by a response frequency of about 16Hz (16 peaks per second) instead of the expected 8Hz (8 peaks per second). This abnormality in the binocular VER indicated some non-specific binocular dysfunction. A similar irregularity in the binocular VER was noted in the previous electrodiagnostic evaluation when binocular VER's were obtained under cycloplegia (Figure 3, condition C). Increasing the check size within the checkerboard target gradually restored the normal periodicity to the binocular VER.

Figure 5 shows the ratio of the binocular VER amplitude to monocular VER amplitude as a function of checkerboard check size. This figure illustrates graphically that binocular cortical responses were smaller than the monocular cortical responses for 14 and 28 minutes of arc check sizes. Negative interaction[5] between monocular inputs was suggested by this observation. The expected enhancement of binocular VER amplitudes (referred to as "binocular facilitation[6]) was seen only for the 56 and 112 minute check sizes. This sug-

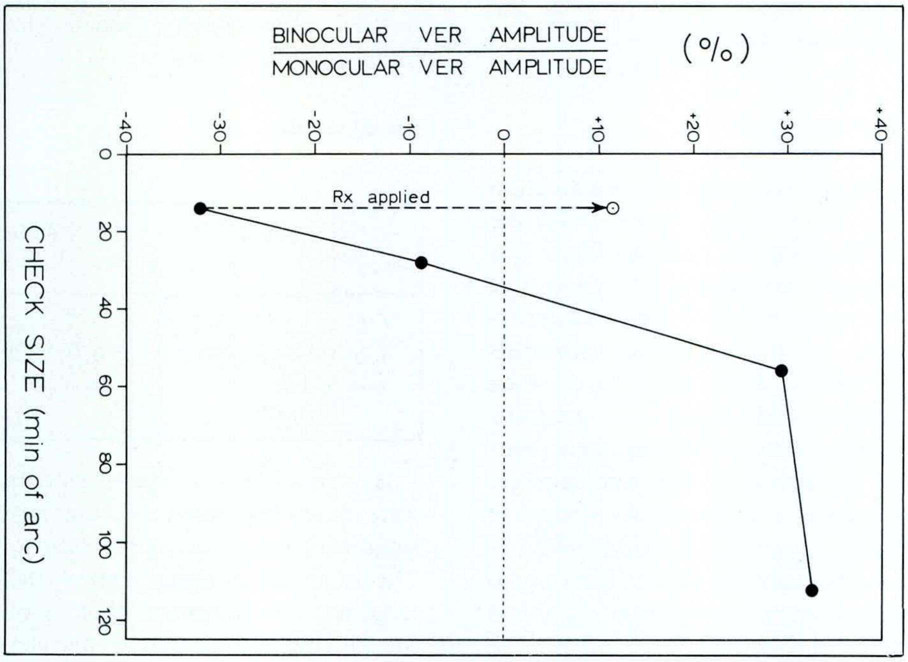

Fig. 5 Graph showing the ratio of the binocular VER amplitude to the monocular VER amplitude, in percent, as a function of the VER checkerboard check size. Negative interaction was seen for the 14 and 28 minutes of arc check sizes while binocular facilitation, occurred when the checkerboard check size was increased to 58 and 112 minutes of arc. The vertical broken arrow illustrates that binocular facilitation occurred for even the smallest check size when the correction for hyperopia was applied. This observation indicated measurable physiological enhancement of binocular function when the correction for hyperopia was worn.

gested that physiologically normal binocular function for this patient could only be expected for larger sized objects (greater than 20/20 letter size) when no correction for the demonstrated hyperopia was worn. However, when the hyperopic prescription was applied a "binocular facilitation" of approximately 12% was measured for the standard check size of 14 minutes of arc (Figure 5). In an additional test, a binocular facilitation of approximately 280% was noted when the patient viewed a checkerboard target composed of 7 minutes of arc checks through a correction for the manifest hyperopia. These latter two observations on binocular function together with subjectively measureable improvement in visual acuity with the correction for hyperopia strongly indicated the need for glasses if visual function was to be facilitated in this patient. Glasses were prescribed for the manifest hyperopia (+1.50DS) and the patient was instructed to wear them for all visual tasks. Since no abnormalities with ocular motility could be identified when the prescription was worn, no other therapy was considered necessary at that time. The patient will be monitored at six month intervals to insure continued normal visual function.

Discussion

When confronted with a patient claiming markedly decreased form vision in one or both eyes, a clinician must determine whether the reduction in visual acuity is organic or functional[7] in nature. Normal pupillary light reflexes and a healthy appearance of the optic nerve heads and macular areas *per se* are insufficient grounds for ruling out an organic process causing the reduction in vision. A diagnosis of a functional decrease in vision is appropriate only when additional tests such as electroretinography[3] (ERG) and VER's have demonstrated normal physiological responsiveness of the retina and retino-cortical pathways subserving vision.

The nature of the disorder causing the reduction in vision in our patient, an accommodative spasm, was suggested by several observations in the course of the standard oculo-visual assessment. These observations included the following: (1) Large differences in the estimates of visual acuity obtained in the first and second examination (20/1600 vs 20/800), (2) Poor reading of most letters that could be seen, (3) Fluctuation in visual acuity within a single examination period, (4) Fluctuation in the retinoscopic reflex notably in one eye, (5) Binocular visual acuities that often were worse than monocular acuities, and (6) Improved but, nevertheless, reduced and fluctuating visual acuities even when a correction for the manifest refractive error was applied. These six observations could also have led to a diagnosis of malingering. This possibility, however, was clearly ruled out by the results of pattern VER testing; the clearly demonstrable abnormality in the VER waveform for a reversing checkerboard target with standard check sizes (Fig 2) was consistent with the patient's claim of reduced vision. In addition, the significant enhancement of the VER waveform and amplitude associated with an optical correction for an apparent myopic condition served to rule out an organic basis for the reduced vision and confirmed an underlying physiologically normal afferent mechanism for the processing of patterned visual stimuli. This latter observation reduced the patient's visual problem to one that appeared solvable by optical means. The frequent regularity of the waveform of incoming VER's for all checkerboard check sizes confirmed the suspicion of an accommodative spasm formed after the standard eye examination, and ultimately led to the clinical solution of the patient's visual problems. As a matter of routine procedure in the electrodiagnostic clinic, selected computer averaged bioelectric potentials are displayed on an oscilloscope and shown to the patient. For the case reported here, the demonstration of improved VER's with a spectacle correction proved to be not only a tremendous morale boost for the despondent parent, but also paved the way for total patient compliance to the proposed therapy that consisted of full-time wearing of glasses.

The visual anomaly diagnosed in our patient falls into a classification of myopia known as "pseudomyopia",[8,9] or "functional myopia". In this condition, a tonic spasm of the ciliary muscle increases the refractive power of an eye thereby making the patient artificially myopic. Patients exhibiting pseudomyopia are usually school age children who may present such symptoms as poor distance vision, either monocularly or binocularly, occasional diplopia, asthenopia, headaches and infrequently, blurred near vision. The intensity of the ciliary muscle spasm is indicated indirectly by the degree to which form vision is impaired in an emmetropic eye. The spasm of accommodation may be sufficiently intense to make emmetropes and even hyperopes myopic. Among the therapies that have been employed in the correction of pseudomyopia are strong plus lenses for near vision or constant wear, base-in prism to inhibit accommodation by relieving convergence, and temporary cycloplegic therapy for severe cases. The magnitude of pseudomyopia most frequently reported is usually quite small, about one diopter or less. The largest magnitude of pseudomyopia reported in recent vision literature was that by Moore and Stockbridge[10] who described a new treatment procedure employed in a group of 12 patients with pseudomyopia ranging from one to seven diopters with an average of 2.5 diopters. In the case we report here, our patient exhibited a more or less continuous accommodative spasm of about 9.5 diopters in the right eye and about 7.75 diopters in the left eye. (These values were derived by summing the amount of myopia measured by retinoscopy without cycloplegia and the amount of hyperopia manifest in a cycloplegic refraction). We believe this to be possibly the largest accommodative spasm reported in clinical literature.

A second exceptional feature of this case of pseudomyopia was the total absence of any symptoms of visual distress, other than poor distance vision. Our patient denied diplopia, asthenopia, or headaches. The most likely explanation for the absence of symptoms related to binocular stress in the presence of the large accommodative spasm was the fact that this patient demonstrated a low gradient AC/A value and a good negative fusional vergence amplitude. Both of these statistics would tend to minimize the likelihood of a convergence spasm or transient convergence excess.

Another interesting feature of this case was the unequal refractive errors created by the ciliary spasm; the right eye was assessed to be about two diopters more myopic than the left eye. In addition, the refractive status of the right eye tended to be quite constant while the refractive power of the left eye was seen to fluctuate by about one diopter or more. These observations raised the possibility that in pseudomyopia there may be asymmetrical motor innervation to accommodation. Alternatively accommodative innervation may be symmetrical but functional or structural differences in the intra-ocular mechanisms for accommodation may produce the anisometropia.

An examination of vision literature reveals various theories on the etiology of pseudomyopia. Accommodative spasms creating pseudomyopia may be triggered by binocular anomalies such as large exophorias or extropias[11]. In these cases, the accommodative spasm represents an attempt by the accommodative convergence associated with accommodation to control the exodeviation. In this manner ciliary spasm effectively prevents diplopia but also causes blurring of the single binocularly viewed objects. Pathological processes such as irritative lesions in the brainstem[12] have also been reported to cause accommodative spasms, presumably by abnormal stimulation of brainstem mechanisms controlling ocular accommodation. There is ample documentation in clinical literature that emotional disturbances can result in functional anomalies in the visual system, with young girls around the age of 10 years tending to show more emotionally based visual disturbances than boys in the same age group.[13,14] The most common psychogenic disturbances of vision are clinically unexplainable decreases of visual acuity and characteristic concentric or spiral constrictions of the visual field. Just how emotional conflicts are converted into conditions simulating organic disorders in what is called the "conversion reaction"[15] is not known. Common childhood conversion reactions to psychological stress are headaches, abdominal pain, fatigue and most commonly, a decrease in visual acuity. The conversion symptom of decreased visual acuity typically occurs in the absence of any ocular pathology or significant refractive error. The reduction in visual acuity experienced by our patient was apparently induced by easily resolvable emotional conflicts that were centered on sibling rivalry and admitted parental conflict. Unlike psychogenically induced amblyopia where there is no apparent cause for the reduction in acuity, our patient's emotional problems were converted to a clinically measurable ciliary muscle spasm that led to the decrease in visual acuity. The functional origin of the accommodative spasm was indicated by the remarkable improvement in visual acuity (from 20/800 to 20/20) within a period of only a few days; the only therapies employed to relieve the large decrease in visual acuity were judicious counselling concerning possible ways to reduce the emotional stress experienced by the patient in the home and school environment, and the provision of glasses for the relief of a reduction in visual acuity and physiologically identifiable binocular stress caused by the small amount of hyperopia. The magnitude of the hyperopia corrected with glasses was clearly not large enough to account for the entire decrement in visual acuity experienced by the patient on initial entry into the electrodiagnostic clinic.

In summary, a diagnosis of pseudomyopia is ordinarily dependent on the symptomatology and the detection of emmetropia or hyperopia by static retinoscopy. In the absence of the aforementioned symptoms of pseudomyopia and the detection of a large myopic refractive error by retinoscopy, a definitive diagnosis becomes more problematical. In the present case, the results of VER testing helped to elucidate the nature of the visual anomaly and provide guidance as to the procedures to be employed for the successful resolution of the problem.

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Canadian Society of Aviation Optometry

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CASE REPORT

Convergence Insufficiency Occurring In Presbyopia

W.R. Bobier*

Introduction

The diagnosis of muscle imbalance has traditionally been made through consideration of Sheard's and Percival's criteria and measures of fixation disparity[3,4]. Sheard's criterion requires that the opposing fusion vergence limit be twice the magnitude of the phoria. Percival's criterion implies that vision comfort is achieved near the middle of the vergence range.

Presbyopes show relatively large amounts of exophoria when tested at near through the reading correction. Morgan[7] found the near phoria to average 9$^{\Delta}$ exophoria for presbyopes compared to an average of 3$^{\Delta}$ exophoria for prepresbyopes. The high exophoria can be interpreted as arising from the decreased accommodative vergence available when the near target is viewed through the reading addition. The high exophoria is often tolerated under normal binocular viewing conditions when a stimulus to convergence is present; since presbyopes, unlike prepresbyopes, can exhibit changes in convergence without suffering changes of accommodation[2]. Sheedy and Saladin have proposed that the assessment of fixation disparity at near is an important measure of presbyopic muscle balance as it is a binocular test; hence, a stimulus to convergence is provided.

It is the purpose of this case report to illustrate the use of Sheard's and Percival's criteria and fixation disparity as diagnostic indicators of a muscle imbalance occurring in a presbyopic patient. These indicators will be further utilized to measure the efficacy of orthoptic treatment given to relieve the imbalance.

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The Case

Patient E.S., age 65, complained of asthenopia after one hour of reading. Doubling of the newspaper print was reported. Frontal headaches often followed. An ocular health assessment had been made previously. A medical examination had been advised as observation of the fundi had revealed signs of hypertension.

Refractive examination revealed compound hyperopic astigmatism and absolute presbyopia, which was corrected with his present spectacle prescription.

O.D. +1.75 - 1.00 x 095 ≃ +2.25 VA 20/20

O.S. +1.75 - 1.00 x 085 ≃ +2.25 VA. 20/20

The binocular findings are outlined in Table I as pre-therapy results. These findings suggest the presence of a convergence insufficiency.

Therapy

Treatment was given over a 3 week period, in which the patient spent a minimum of 20 minutes a day on prescribed home exercises. Two office visits were made at one week intervals during this period. Office and home exercises were designed to increase the positive fusional vergence limit. The techniques used included loose prisms, vectograms, pencil push ups, beads on a string and free fusion stereorings.

The binocular functions were reassessed after the orthoptic programme. (See Table I post-therapy). The patient reported that reading was more comfortable and headaches were absent.

Results

Considering the post-therapy findings in Table I, the effects of training have been:

1. to increase the positive fusional vergence limits by a minimum of 15$^{\Delta}$ at both 6M and 40cm such that Sheard's and Percival's criteria were met.
2. to reduce the near exofixation disparity so that no base in prism was required to relieve it.
3. to eliminate the tendency of periodic suppression when reading.
4. to reduce the asthenopia.

Discussion

Daum[9] has shown that the positive fusional vergence amplitude can be significantly increased after three weeks of training for a population of prepresbyopes with normal binocular vision. The present case suggests that the positive fusional vergence limits can be improved in a presbyopic individual in a similar time frame. It would appear that the plasticity of this oculomotor system remains well into presbyopia. This finding is in agreement with other studies.[4]

The diagnosis of the imbalance was determined by the fact that Sheard's and Percival's criteria were not met, and that a significant amount of base in prism was required to eliminate the fixation disparity. These same indicators appeared to adequately indicate when the oculo-

Table I
Binocular Findings for Pre-and Post-Therapy Assessments

Test	Pre-Therapy	Post-Therapy	Change
6 M			
Unilateral Cover Test	non strabismus	non strabismus	
Phoria von Graefe	2Δ exo	1Δ exo	not significant
Maddox Rod	1Δ exo	ortho.	not significant
pfv limit von Graefe	6Δ	21Δ	increased by 15Δ
loose prism	10Δ	25Δ	increased by 15Δ
nfv limit von Graefe	6Δ	7Δ	not significant
loose prism	6Δ	6Δ	not significant
Prism to relieve fixation disparity (Mallet)	1Δ B.I.	0	
Sheard's Criterion	met	met	
Percival's Criterion	met	met	
40 cm			
Unilateral Cover Test	non strabismus	non strabismus	
Phoria von Graefe	16Δ exo	11Δ exo	reduced by 5Δ
Maddox Rod	12Δ exo	12Δ exo	not significant
pfv limit von Graefe	10Δ	28Δ	increased by 18Δ
loose prism	10Δ	25Δ	increased by 15Δ
nfv limit von Graefe	24Δ	18Δ	reduced by 6Δ
loose prism	14Δ	16Δ	not significant
Prism to relieve fixation disparity (Mallet)	5ΔB.I.	0	reduced to ortho fixation disparity
Sheard's Criterion	not met	met	
Percival's Criterion	not met	met	
Suppression of 0.37M print on Vectographic Near Card	yes, intermittent	none	
Asthenopia	present	absent	

motor system was brought to within normal limits which was also accompanied by a subjective improvement of reading comfort.

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CASE REPORT

Pediatric Vision

G. Lecker*

Jennifer M. aged 7. Grade 1.

Jennifer presented for examination because, as her mother said, "She is getting nowhere in school and will not do any of her work." Jennifer had but one complaint (made to her mother): that of sore eyes.

Jennifer was neat and tidy but very shy, almost to the point of withdrawal, and during the whole of her examination never spoke to me. Her history showed her to have been of normal term at birth with no complicating factors during the mother's pregnancy. Jennifer's development showed no abnormalities and there was no history of illness with high temperatures or convulsions. The family history showed a diabetic tendency on the maternal side.

Jennifer was co-operative in testing visual skills which showed poor saccadic and pursuit movements of her eyes. Convergence was inaccurate (far to near and vice versa) and unstable; cover testing revealed wide divergences with poor recovery on exposure. Hand and eye co-ordination was not good and the patient could not catch a ball bounced to her. Her mother indicated that Jennifer tended to trip over her own feet, which could have her shoes reversed (she also reversed letters). Questioning showed that the child had a laterality problem, not knowing right from left. Jennifer's ability to color simple pictures was erratic and her attempts to reproduce simple drawings produced frustration. The patient's V.A. for each eye at distance was 20/20 and 20/25 for near. Binocular vision and fusion were present. Patient's lids showed slight blepharitis marginalis O.U. Pupil reflexes were normal. Ophthalmoscopy failed to reveal the presence of pathology.

Retinoscopy indicated accommodative spasm. Repeating the procedure at near while the patient was viewing a teddy bear or rabbit affixed to the top of the retinoscope (a spot retinoscope is used in all instances) showed +.25 dioptres in each eye.

The small amount of plus was prescribed together with training on a balance beam, laterality training ("Angels in the Snow") and convergence training — catching a ball bounced to her (also an aid to hand-eye co-ordination) and, later, the transfer of candy cake decorations on the end of her finger to her mouth with constant observation of the slowly moving finger.

Jennifer was re-assessed in three months. After some cajoling on the part of her mother, the child had begun to wear her glasses. Retinoscopy showed no radical changes in her accommodative patterns. Jennifer had learned left from right and got her shoes on correctly. The rest of her testing showed similar results as on the initial visit. Continued training and wear of her glasses was advocated.

The sixth month assessment was a different story — Jennifer actually said "hello" and presented me with a picture she had drawn (terrible by any standards, but a picture). There was a marked improvement in saccadics and pursuits, and Jennifer could converge with relative ease but with some difficulties in maintenance — she could now catch a ball. Cover testing showed slightly less divergence of eye under cover. Retinoscopy showed no spasm in accommodation with more plus correction at a later date. Near V.A. had improved to 20/20 for each eye. No changes were made in glasses or her training.

At the end of one year Jennifer was far less retiring. She liked to color and her pictures were gradually assuming some symmetry and cohesion. Eye movements were very well executed and convergence was being maintained. The patient's printing was on line and letters were of equal size, without reversals. Her lens correction was changed to +.75 O.U.

All this occurred 10 years ago and as she went on in school Jennifer continued to improve in her efficiency. She began to take piano and art lessons becoming quite proficient in both fields. Now, aged 17, this is a well-rounded "young lady," doing well from a scholastic and social standpoint. She no longer wears a refractive correction (but may have need of one again later). If these measures had not been adopted on her behalf, we can only guess what she would or would not be capable of to-day and would have to wonder if she would be socially involved with her peers.

The system of treatment does work, why not use it?

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Papilledema in Juvenile

D.A. Porter*

Advance

This is a case report of advanced papilledema in a nine-year old white female of Ukrainian descent. The study is presented to emphasize the undetected presence of a severe condition through several months of home and school involvement, and a recent general physical checkup with her family physician, as well as its prognosis.

Case Description and Chief Complaint

The young lady, a Grade four student, presented at my office on March 15, 1976 complaining that her distance acuity did not seem clear and she could not see the chalkboard in school. Case history revealed this to be her first eye examination and that she had first noted the initial slight blur as far back as the fall of the previous year when starting Grade four. She had mentioned it at home, but the blur problem did not seem serious enough to pursue at that time. The patient had just been through a general routine medical checkup and there was no mention to her physician about any visual disturbances, and in turn, no other finds had been recorded to indicate any problem with her general health. As well, her dental health had been checked and treated uneventfully.

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Diagnostic Data

Initial (uncorrected) visual acuities:

at 6 m	**at 40cm**
OD 20/50+	very reduced
OS 20/40	acuity and accommodative abilities

Best corrected visual acuities:

at 6 m	**at 40cm**
OD 20/25	
OS 20/25	as above

(but difficult to achieve)

Use of pinhole disc did not significantly improve the acuities with unstable Rx of:
OD 0/-1.00 x 075
OS 0/-1.25 x 095

There was some suspicion of malingering at this point due to the inconsistent and unreliable answers. I suspended remaining binocular examination procedures in favor of external and internal ophthalmoscopic examination to assess ocular health.

External examination of the eyes and adnexa was unremarkable with only a slight left upper lid ptosis of unknown origin or duration.

Fundus examination, however, was remarkable and alarming. Both discs were very edematous with all margins obscure. The retinal vessels showed increased tortuosity with a marked increase in the AV ratio due to venous dilation. The retina displayed a number of small intraretinal hemorrhages and the retinal grounds were of poor quality and color, with large pigmented blue-green areas encompassing most of each retina.

Discussion and Conclusion

With her physician in the same office area as myself, I conferred with him and found he had not done an internal ocular investigation, because the patient was coming to my office for a complete eye examination.

It was decided, in the interest of time, to refer the patient to an ophthalmologist whose office also included a neurologist. The eye report concurred with our recorded findings and chronic papilledema was diagnosed with a follow-up neurological assessment revealing a tumor at the base of the brain (Blasto-cytoma), which required immediate removal as it was considered life threatening at this late time. Most often the central acuities are not affected in papilledema unless the condition persists for some time. As well as reduced acuities centrally, it can also lead to development of a secondary type of optic atrophy which, fortunately, did not happen here.

Follow-up examination on July 2, 1976, three and one-half months following surgery for removal of the tumor, revealed complete recovery with no lingering eye signs, no physical impairments and acuity easily correctable to 20/20 OU with a simple myopic correction.

This case is presented to indicate not only how easily this pathologic condition can exist undetected, even under the scrutiny of other professionals, but also to show how necessary it is to provide immediate corrective attention and how favorable a prognosis can result.

HISTOIRE de CAS

Vision Pédiatrique

G.B. Dufresne*

Histoire

M.S., un garçon de 5 ans, est référé en août 1979 par un confrère pour amblyopie de réfraction. Selon la mère, l'oeil gauche ne voit pas bien mais ne semble pas dévier. Il n'y a pas d'antécédents familiaux.

Résultats cliniques

L'acuité sans correction est o.d. 20/20 et o.g. 20/200 à la charte des E directionnels. La barre de prismes révèle une ésotropie gauche de 6△ au loin, et une ésophorie de 10△ à 40cm. Il y a suppression de l'oeil gauche au loin, et une réponse de diplopie de près. La fixation de l'oeil gauche est instable.

Le titmus Stereo Test est utilisé pour mesurer le stéréopsis de près. M.S. perçoit la mouche, les animaux et le premier cercle. La charte vectographique de American Optical permet de mesurer le stéréopsis au loin. M.S. ne perçoit aucun cercle qui s'avance.

La réfraction montre o.d. + 0.75 20/20
o.g. + 5.00 20/200

Traitement

La correction intégrale est prescrite. Les parents sont avertis de l'éventuelle nécessité de lentilles cornéennes. Dès réception de la lunette, un horaire de cache est prescrit devant l'oeil droit.

Un mois plus tard, en septembre 1979, l'acuité de l'oeil gauche est 20/30 par lettres séparées et 20/40 pour une ligne complète. Le cover-test démontre une ésophorie de 4△ au loin et de 10△ de près. A la charte vectographique au loin, M. S. réussit à percevoir un cercle plus avancé que les autres pour 2 des 4 rangées, soit une stéréoacuité de 180 secondes d'arc (34% selon les pourcentages de Shephard). De près, il réussit 2 des 9 cercles, soit 400 secondes d'arc ou 16% de stéréoacuité.

L'horaire de cache est allégé et des exercices de précision sont donnés. Ce sont d'abord des jeux où l'oeil et la main travaillent ensemble: casse-tête, livre à colorier, dessin, découpage, boules à enfiler, etc.

Puis viennent des exercices où l'oeil a un rôle plus important que la main, où il lui sert de guide: labyrinthes de plus en plus complexes, tracés à suivre de l'oeil, Lite-Brite, etc.

Finalement, des exercices sont prescrits où M.S. doit se servir de son oeil gauche pour raisonner et mémoriser: jeux de différences et de similitudes, dominos, tic-tac-toe, jeux visant à développer l'empan perceptif et la mémoire visuelle.

La mère augmente graduellement le degré de difficulté des exercices selon la performance de M.S. Il y a suffisamment de variété pour maintenir sa motivation.

En octobre 1979, l'oeil gauche a une acuité de 20/25 pour une ligne complète. Il n'y a plus de suppression. La stéréoacuité est de 180 secondes d'arc au loin et 140 secondes d'arc de près (41% selon Shephard). Cela représente 4 points sur 9. Le port de la cache est discontinué, mais M.S. fait toujours des exercices de précision.

En août 1980, l'acuité de l'oeil gauche est 20/20 pour une ligne complète. La stéréoacuité au loin est stable à 180 secondes d'arc. De près, il réussit maintenant 8 des 9 cercles, soit une stéréoacuité de 50 secondes d'arc (72% selon Shephard). Les exercices sont arrêtés.

En septembre 1981, soit un an plus tard, l'acuité visuelle est toujours aussi bonne. Maintenant que M.S. va à l'école, l'ésophorie semble le fatiguer. Le cover-test montre une ésophorie de 4△ au loin et de 12△ de près, avec suppression intermittente de l'oeil gauche. Une bi-lentille est prescrite: o.d. + 1.50 add +2.50
o.g. +5.00

Le foyer est de type "exécutif" afin de fournir un champ de vision assez large de près.

Le vectogramme "Basic Fusion" de Bernell Corporation est utilisé afin de tester la binocularité de près lorsque M.S. regarde plus bas que le centre optique des lentilles. Ce test ne révèle aucun problème de déviation verticale. L'utilisation de lentilles bi-centriques n'est donc pas envisagée.

Depuis ce jour, M. S. fonctionne bien et n'a aucune plainte subjective. Toutefois, si des symptômes d'inconfort liés à une phorie verticale apparaissent, des lentilles bi-centriques ou des lentilles cornéennes seront proposées.

Conclusion

Lorsqu'il y a anisométropie chez un enfant, il est important de prescrire la correction intégrale le plus tôt possible. Un programme d'entraînement visuel bien suivi peut amener une amélioration intéressante de la binocularité.

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Increasing Diagnostic Potential in Pediatric Optometry by Electrophysiological Methods

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Abstract

With the advent of modern-day technology light-induced electrical activity in the retina and visual cortex can be measured clinically to assess visual function. The Electroretinogram (ERG) and the Visually Evoked Response (VER) are now routine clinical tests used to evaluate the physiological integrity of retinal and visual cortical mechanisms respectively. The theory, and application of these non-invasive, objective tests in the evaluation of various aspects of vision in infants and children are discussed. Numerous case reports are presented to illustrate the extended diagnostic capability afforded the pediatric optometric practitioner by the ERG and VER.

Abrégé

La technologie moderne nous permet de mesurer le potentiel électrique de la rétine et du cortex induit par des éclairs controlés de lumière et ainsi vérifier l'intégrité de la fonction visuelle. Le ERG et le VER sont des tests routiniers utilisés pour vérifier l'intégrité physiologique des structures de la rétine et du cortex visuelle respectivement. La théorie et l'application de ces procédures "non-chirurgicales" et objectives dans l'enquête même sur la vision des enfants sont expliquées. On présente plusieurs histoires de cas pour illustrer comment la capacité diagnostique du practicien en pédiatrie est rehaussée par le ERG et VER.

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Introduction

Vision literature abounds with statements on the necessity of early detection and remediation of visual anomalies to prevent amblyopia, and irreversible sensory deficits.[1-5] In a series of papers, Ingram[6-8] has reported changes in refraction in children between one and three years of age which indicate the necessity for assessment during the first year of a child's life, as well as continuing frequent surveillance if amblyopia is to be prevented. Thomas and Mohindra[9] have shown that most infants respond quickly to amblyopia therapy lending further support to the necessity of early correction. Despite this overwhelming evidence the majority of children under five years of age remain without vision care until they enter school or are found, often inadvertently, to have a vision problem. This situation can be corrected by Optometrists becoming politically more active in the implementation of preschool screening programs[10,11] and educating parents and persons of child bearing age to seek optometric care for their children at a very early age. Another area where optometrists must spend time is in educating family physicians and pediatricians of the necessity for an early vision examination.

The University of Waterloo Pediatric clinic patient load provides evidence that the activity in preschool screening programs results in a large number of children being referred for further optometric care. As the majority of this clinical population is made of children under five, a significant portion of the oculovisual assessment necessarily involves objective testing procedures which have been described elsewhere.[12]

While standard clinical procedures such as retinoscopy, keratometry, and cover tests, can yield accurate assessments of ocular refraction and binocularity, the practitioner until recently has had to rely on behavioral responses of the child over a period of weeks to months to evaluate the effectiveness of any applied optical therapy. Subtle irregularities in the appearance of the ocular fundi in the absence of visual symptoms have often been classified "within normal limits" by optometrists and ophthalmologists alike. This was largely because accurate measurements of visual function could not be carried out in a majority of children under three by the standard optometric means. However, the advent of non-invasive electrodiagnostic tests of visual function has greatly expanded and improved the diagnostic capability of the optometric practitioner as well as providing him with a powerful clinical tool with prognostic value. The clinical feasibility of electrodiagnostic tests has added broad, new dimensions to the visual examination of infants and nonverbal populations.

It is the purpose of this paper to describe briefly the utility of two electrodiagnostic procedures in the detection of abnormalities in the visual system of infants and children. Whereas a systems examination[12] provides valid and reliable data on which a practitioner can originate therapy, the ability to access an electrodiagnostic service can reassure the practitioner that therapy based on both data sources will optimize binocular visual input. The practitioner who obtains such information can thus be more effective in prescribing, counseling, and reassuring the child's parents that the diagnosis and prognosis are sound since he has direct physiological evidence of the value of corrective lenses or prisms which form the basis of the therapy recommended.

The two main electrodiagnostic tests of visual function employed at the University of Waterloo, Electrodiagnostic Clinic, are 1) Electroretinography (ERG) and 2) the Visually Evoked Response (VER). A brief description of these tests together with case examples illustrating the usefulness of these procedures in evaluating various aspects of the visual system in infants, children and adults follows.

Electroretinography

Diffuse Flash ERG's

Electroretinography[13-15] is an electrodiagnostic procedure that assesses objectively the functional integrity of outer and inner layers of the retina. The testing procedure involves the painless application of the recording electrode close to the eyeball near the lid margin (periorbital electrodes) or directly on the cornea (corneal electrodes) and measurement of electrical changes occurring within the eye in response to quantified diffuse flashes of light. (See Fig. 1-A). A normally functioning retina is identified by electrical responses with characteristic polarities and waveforms. A classical ERG is composed of "a", "b", "c" and "d" waves. The clinically useful components of the ERG pattern are the "a" and "b" waves. (See Fig. 1-B). Animal experimentation and clinical studies suggest that the cornea-negative "a" wave is generated by the photoreceptors (rods and cones) while the cornea-positive "b" wave is thought to be produced primarily by the Bipolar and/or Mueller cells. While it is generally accepted that the ganglion cell layer and the optic nerve do not contribute to the flash ERG, the role of ganglion cell activity in the generation of the "pattern ERG"[16] is at present an unsettled issue.[17,18]

A. Scotopic ERG's

The functional integrity of the rod type retinal photoreceptors can be evaluated by dark adapting the patient and measuring the retinal response to specially selected light stimuli. The dark adaptation procedure maximizes the sensitivity of the rods thereby allowing an assessment of the physiological responsiveness of those retinal elements primarily subserving night-time vision. When fully dark adapted, depending on patient compliance, either periorbital or corneal ERG electrodes are used to record the ERG. Light flashes are presented within a ganzfeld stimulator[13] which provides uniform retinal illumination. Photo-induced retinal responses to several brief light flashes are then averaged by a computer of averaged transients. These test flashes ordinarily consist of scoptopically matched blue and red light, as well as white light. These test flashes elicit the "rod isolated" (exclusively rod responses), "rod dominated" (primarily rods with some cone contribution), and "mixed" ERGs (both rod and cone responses) respectively. The waveform of the ERG representing the average of a preselected number of consecutive ERGs is analyzed by measurement of the "a" and "b" wave latencies, amplitudes and implicit times (peak times). These parameters are then compared to established norms to arrive at a diagnosis concerning retinal function.

Figure 2 illustrates scotopic ERGs obtained with periorbital electrodes for a patient with normal rod-cone function, and a thirteen year old girl (LB) who was diagnosed as having retinitis pigmentosa sine pigmento. LB presented with symptoms of impaired vision at night-time with

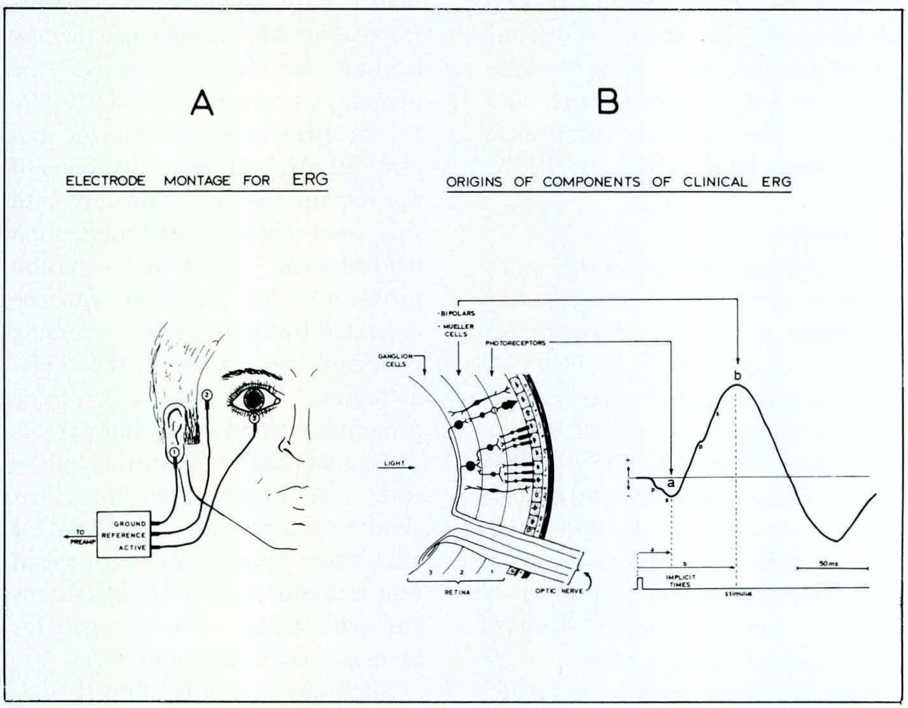


Fig. 1

A) Schematic diagram showing the relative positions of the active electrode (3), reference electrode (2), and ground electrode (1) used to record the ERG. Each surface electrode is held in place by small strips of adhesive tape. Good electrical contact between the skin and the electrodes is insured by an electroconductive gel placed on the contact surface of the electrodes. The periorbital positioning of these electrodes allows ERG recordings in apprehensive adults and children.

B) Sagittal view of the retina showing the first (photoreceptors) second (bipolars) and third (ganglion cells) order neurons in the visual system. An idealized ERG with the presumed neural generators of its primary components is shown to the right side of the retina. Note that the ganglion cells do not contribute to the ERG.

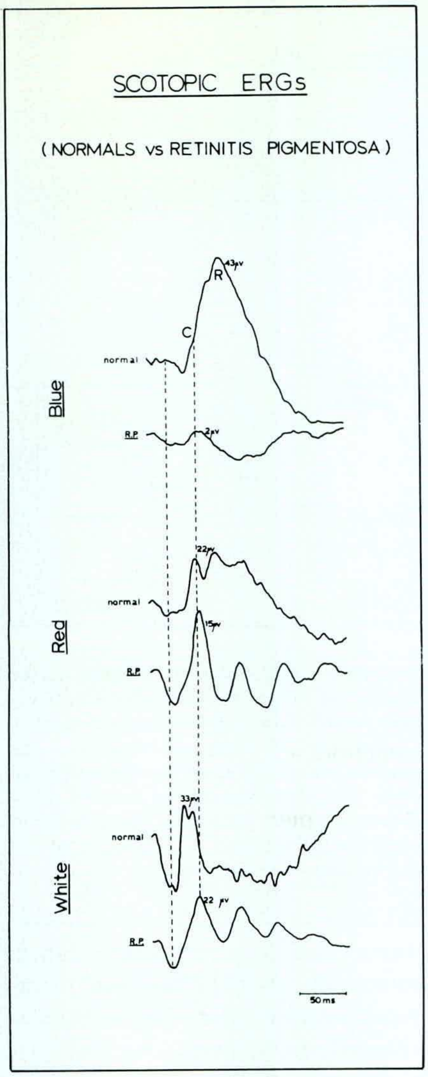


Fig. 2
Scoptopic ERGs elicited from a normal adult (top traces for each type of light flash) and a 13 year old girl with retinitis pigmentosa (bottom traces for each flash). Each record is the average of twenty, 200 msec responses recorded with periorbital electrodes positioned as illustrated in Fig. 1A. The vertical dashed lines facilitate comparison of the salient temporal characteristics of the ERGs for the normal and RP patient. R and C designate the rod and cone contribution to the 'b' wave respectively. Note that the ERG of the retinitis pigmentosa patient is lacking a rod component and therefore is primarily a cone dominated response.

daytime vision and visual acuity being "normal". An ophthalmoscopic examination did not reveal any peripheral pigmentary changes characteristic of retinitis pigmentosa. In the case of the normal observer, a blue flash elicited an ERG with a prominent "b" wave. A red flash elicited an ERG with a double-peak "b" wave. The first peak in the "b" wave corresponded to the contribution of the faster reacting cone photoreceptors to the scotopic ERG while the second peak represented the input of the slower rod photoreceptors. A white flash elicited a large amplitude ERG with a prominent "a" and "b" wave. Note that the peak of this "b" wave occurred earlier than the peak of the "b" wave in the rod dominated ERG elicited by the red flash, which in turn occurred before the peak of the rod isolated ERG "b" wave elicited by the blue flash. In the case of the youngster with retinitis pigmentosa, a blue flash failed to elicit any significant response from the rods. Note that the blue light elicited a small "a" wave and a small portion of the "b" wave. The implicit time of this small peak coincided with the photopic (cone) contribution to the scotopic ERG elicited by a red flash. A red flash elicited a prominent "a" wave and "b" wave with a waveform that was distinctly different from that seen in the normal observer. The peak of the "b" wave coincided with the first peak in the "b" wave of the ERG for the normal observer. This indicated a strong response from cone photoreceptors without a response from the rods. A number of oscillations of decreasing amplitudes followed the cone dominated "b" wave. A white flash elicited a prominent ERG, with the peak of the "b" wave coinciding in time with the peak of the "b" wave elicited by the red and blue light flashes. The implicit time of the "b" wave in this case was somewhat delayed when compared to the normal response. The nature of the ERG responses described above indicated a pathological dysfunction of rod photoreceptors with normally functioning cones. This example illustrates that retinal physiology may be severely impaired even when the ocular fundus appears normal on ophthalmoscopic examination and emphasizes the need to evaluate retinal physiology before ruling out retinal disease. The evaluation of retinal physiology is equally important when fundus signs suggest retinal disease (e.g. pseudo-retinitis pigmentosa) but where no functional impairment exists.

B. Photopic ERGs

Retinal cone function can be readily assessed by light adapting the patient for about a five minute period to a 10 ft. L, white light background within a ganzfeld. This light adaptation procedure maximizes the sensitivity of the cone photoreceptors thereby allowing an assessment of the physiological responsiveness of those retinal elements primarily subserving daytime vision. Then the same stimulus and analysis procedures described above for scotopic

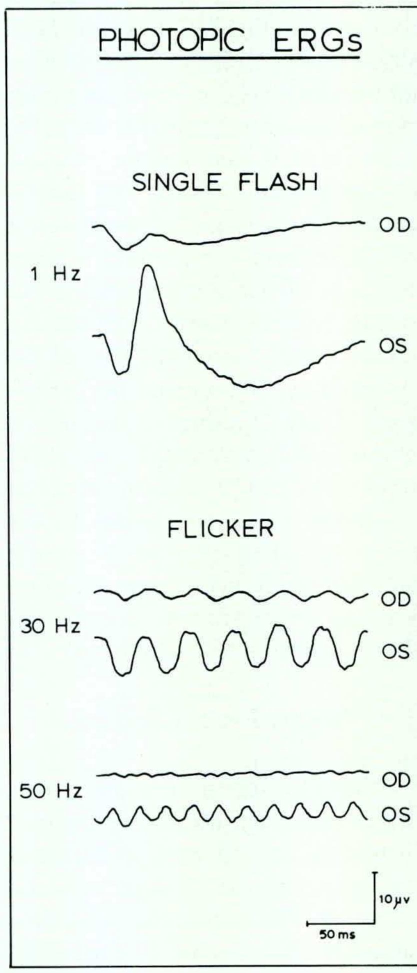


Fig. 3
Photopic ERGs elicited for the right and left eye of an adult patient. Each trace is the average of twenty, 200 msec. responses. Single flash ERGs elicited by a white flash indicated an abnormal response for the right eye. A selective minification of the 'b' wave characterized the ERG for the right eye. Flicker ERGs elicited by flashes delivered at a frequency of at 30 Hz and 50 Hz assumed a typical sinusoidal waveform corresponding to a series of connected 'b' waves. Under light adaptation conditions, and high flash frequencies, the ERG is generated exclusively by cones. The reduced amplitude of the flicker ERG for the right eye 30 Hz and extinguished response at 50 Hz indicated a gross abnormality of retinal physiology.

ERGs are repeated for the light adapted observer. Cone function can be assessed further by eliciting "flicker" ERGs with red light flashes delivered at a high flash frequency, typically 30-60 Hz. The combined conditions of light adaptation, high flash frequencies and the use of light with a spectral composition restricted to the long wavelength portion of the visible light spectrum insure that the responses are generated exclusively by the cones. Failure to elicit either a single flash photopic ERG or the flicker ERG indicates a gross cone dysfunction. Figure 3 illustrates both single flash and flicker ERGs for an adult who likely suffered an occlusion of the central retinal artery in the right eye. It is seen that the "b" wave of the photopic ERG was greatly decreased while the "a" wave was of nearly normal amplitude. Flicker ERGs at 30 Hz were detectable but greatly reduced in size. At 50 Hz the flicker ERG's were extinguished for the right eye but normal for the left eye. These findings indicated a pathological abnormality of retinal physiology and provided a very poor prognosis for normal vision. In this case, the diagnosis of a poorly functioning retina prevented unrewarding surgery for the removal of a dense cataract in the right eye.

Visually Evoked Responses

The electroretinographic procedures described above are useful in detecting disturbances of vision at the retinal level by flash scotopic and photopic ERGs. It is also possible to assess the function of the final stages of the "input" or sensory component of the visual system by a relatively easy to perform but technically sophisticated technique called the Visually Evoked Response (VER).[19] This technique measures the functional integrity of the neural pathways originating at the macular area of the retina and terminating in Brodmann's area 17 of the visual cortex. The VERs are therefore indirect measures of macular function and when combined with flash ERGs are useful in identifying retrobulbar disturbances in afferent visual fibers.

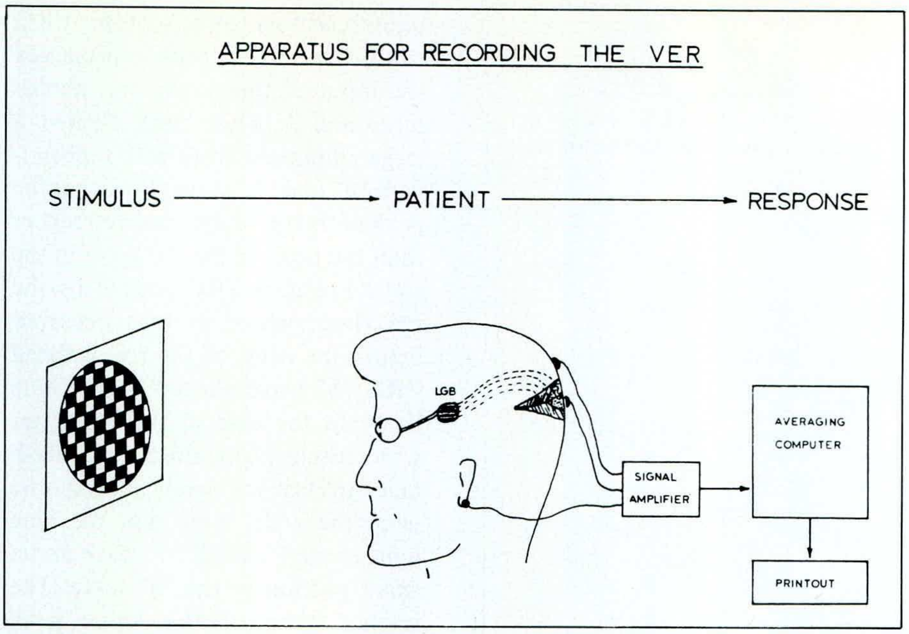


Fig. 4
Schematic illustration of the recording setup for the Visually Evoked Response (VER). The stimulus consists of a checkerboard made up of black and white checks temporally modulated in counterphase. Cortical responses to the checkerboard stimulus are recorded by surface electrodes positioned over the cortical projection of macular areas in the retina. Visually related electrical activity (microvolt range) within the occipital cortex detected by the surface electrodes is differentially amplified and subsequently processed by a computer of averaged transients. The resulting waveform approximates a sinusoid when the checkerboard is reversed at a frequency greater than 4Hz. The number of peaks in the sinusoid is a function of the checkerboard reversal frequency.

The recording of VERs involves placing scalp electrodes over the macular projection to the occipital cortex and computer averaging of the cortical activity elicited by a specially designed visual stimulus. Since the macular area of the retina projects onto the peripheral aspects of area 17 within the calcarine fissure, an electrode positioned 1-2 cms above the inion will record the neural activity resulting from visual excitation of the macular and foveal areas of the retina. (See Fig. 4).

The VER can be elicited by diffuse flashes of light to assess light perception and the integrity of frequency channels in the visual system, or patterned stimuli to assess spatial information channels. The visual stimulus evoking maximal cortical activity for the assessment of form vision is known as the "reversing checkerboard". This stimulus consists of a checkerboard pattern that can be electronically generated on a black and white television screen. The size of each check can be varied and adjacent squares can be alternately shifted ("reversed") from black to white, and white to black at selected frequencies. At any one time, half of the total number of checks visible are black while the other half are white. This arrangement creates a stimulus with distinct pattern reversals but no net change in luminance. Since the average luminance of such a target remains constant, the foveal elements are responding exclusively to the presence of the check pattern within the stimulus and not luminance changes. This type of pattern also is very effective in eliciting strong responses from the visual cortex because most cells resident in the visual cortex are maximally stimulated by complex patterns with sharp borders.

The frequency at which the checkerboard target is "reversed" (checks alternated from white to black to white) determines the waveform of the evoked potentials. At low reversal frequencies (1-3 Hz) visual neurons are activated by the abrupt reversal of the checkerboard pattern resulting in a "Transient

VER" that is characterized primarily by a small negative wave (N-1) preceeding a large positive wave (P-1) which has an implicit time (peak time) of approximately 105 milliseconds (SD +/-5 milliseconds). The amplitude and implicit time of the P-1 component of Transient VERs are important parameters in the clinical evaluation of the functional integrity of macular-cortical pathways. The right hand side of Figure 5 illustrates the Transient VER waveform elicited under monocular and binocular viewing conditions. It is noted in this example that the implicit times of the P-1 component for the right eye (160 msec) and left eye (111 msec) differ greatly with the right eye showing the much slower response. In this example, the very significant delay in retinal-cortical neural transmission was the ocular manifestation of a generalized demyelination disorder of the nervous system (multiple sclerosis).

When the checkerboard is reversed at high frequencies (8-16 Hz) the continuous oscillation of the target causes a rhythmical discharge of visual neurons such that the recorded potentials approximate a sinusoid with the number of peaks in the sinusoid being directly related to the checkerboard reversal frequency. The cortical response pattern elicited by a continuously reversing target is shown as the "Steady-State VER".

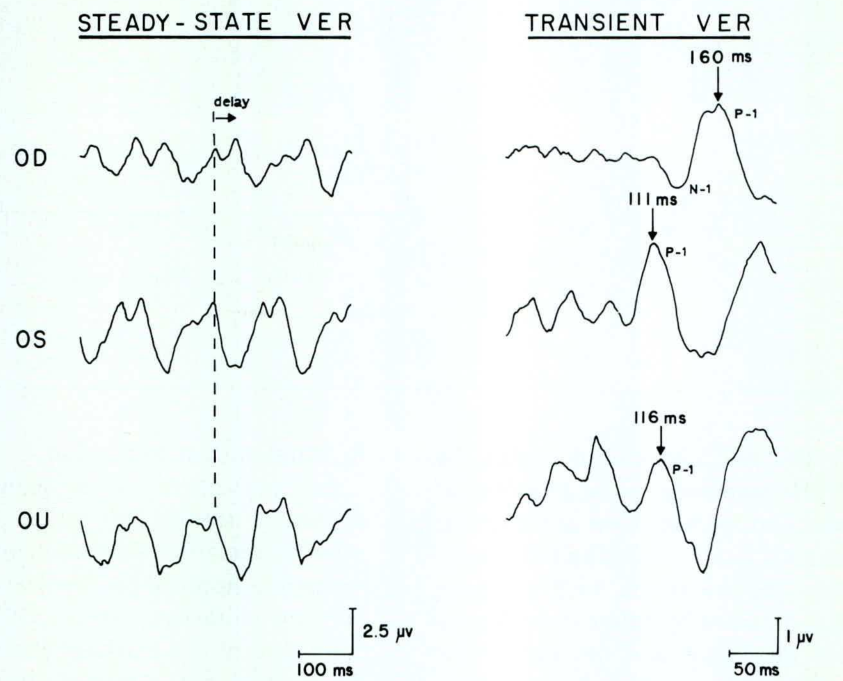


Fig. 5
Sample records illustrating the waveforms of the steady-state and transient VERs obtained for a 42 year old male with multiple sclerosis. Steady-state VERs were elicited by a 6° checkerboard composed of 14 minutes of arc black and white checks reversed at a frequency of 8 Hz. Transient VERs were elicited by the same checkerboard pattern reversed at a frequency of 2 Hz. Each trace is the average of 30 responses. The steady-state VER for the right eye was reduced in amplitude and had a slightly irregular waveform compared to the VER for the left eye. A comparison of the time of occurence of the peaks in the steady-state VERs for the right and left eye indicates a delayed response for the right eye (small horizontal arrow). The difference in retinal-cortical transmission times (approximately 49 msc) was also seen in the transient VERs. The implicit time of P-1 for the left eye was within normal limits. The binocular transient VER was slightly degraded in amplitude compared to the monocular VERs. This suggested some negative interaction between the cortical input from each eye.

The left hand side of Figure 5 presents steady-state VERs recorded from the same patient. Note the clear sinusoidal waveform elicited for the left eye. The VER waveform was slightly degraded and delayed for the right eye likely due to multiple sclerotic lesions in the right optic nerve. However, despite this alteration of the VER waveform and its temporal characteristics, the patient retained a 20/20 level of visual acuity. This latter observation highlights the fact that visual acuity measurements should be considered as only coarse measurements of visual function and ocular health.

Various aspects of vision such as visual acuity, refractive error, and binocular function can be examined objectively by varying the VER stimulus determinants. In addition, VERs can be used as sensitive indicators of sub-clinical and manifest ocular diseases affecting the macular area of the retina, or retrobulbar components of the visual system. The utility of the VER in assessing ocular health and the above mentioned visual functions in children and adults is illustrated in the following sections by case examples.

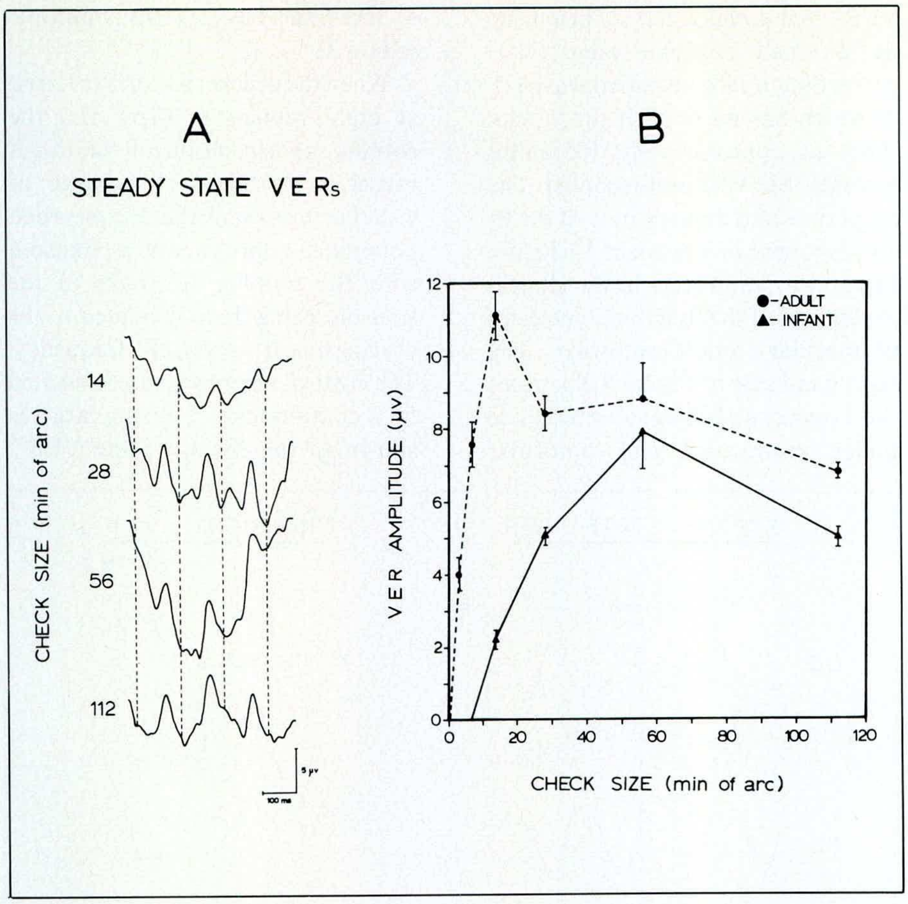
Objective Assessment of Visual Acuity

The following example illustrates the utility of the patterned VER in assessing the resolution function of the human visual system. A four month old infant (LL) underwent a standard oculovisual assessment. The results of the examination revealed a normal appearance of the ocular tissues and adnexa. An ocular motility assessment revealed that the eyes moved freely into all cardinal positions of gaze, and an occasional symmetrical convergence could be induced. The Hirschberg corneal reflex test indicated a non-strabismic condition for near and far fixation. An evaluation of ocular health indicated brisk direct and consensual pupillary light reflexes, clear ocular media, with normal appearance of the optic nerve heads and ocular fundi. An evaluation of ocular refraction indicated a low hyperopic refractive error (+0.75 DS) in each eye. Altogether, there were no indications of any abnormalities within the infant's visual system that could preclude normal visual development. In order to quantify the infant's visual resolution function, she was referred to the Electrodiagnostic Clinic for patterned VER testing.

Fig. 6

A) Binocular steady-state VERs elicited from a 4 month old infant using a 12^0 checkerboard with 14, 28, 56 and 112 minutes of arc checks reversed at a frequency of 8 Hz. Each record is the average of 100, 500 msec responses. The vertical dashed lines isolate the peaks within the VERs. Shifts in the baseline were caused by the infant's head movements. Despite these irregularities in the recordings, the peaks within each trace were clearly visible.

B) Graph illustrating the averaged amplitude of the peaks in the VER as a function of check size for the infant whose VERs are illustrated in A. The vertical bars through each data point represent +/- 1 SEM (standard error of the mean) for VER amplitudes. The VER amplitude for this infant peaked for check sizes subtending 56 minutes of arc. For comparison, the same function is illustrated for the infant's thirty-four year old father whose visual acuity was 20/20. As is typical for most adult observers having a visual acuity of 20/30 or better, the VER peaked for check sizes of about 15 minutes of arc.[29] Thus a check size about 4 times as large as that eliciting the maximal VER in the adult is required to elicit the maximal VER in the infant. In this case, one can therefore predict a potential visual acuity of approximately 20/80 or better for the infant.



The results of the electrodiagnostic assessment are illustrated in Figure 6A. Binocular steady-state VERs were successfully recorded from the infant using the standard checkerboard target positioned one meter away from the infant's facial plane. The ambient light in the examination room was reduced to a minimum to induce the infant to fixate the only luminous object in the room, the checkerboard pattern. The averaging computer was triggered manually whenever the reflex of the checkerboard pattern was judged to be within the infant's pupillary area. One hundred, 500 millisecond responses were averaged in order to obtain a good signal-to-noise ratio. The results indicated that there was a recordable but poorly defined VER pattern in response to a checkerboard target composed of 14 minutes of arc black and white checks. The amplitude of the binocular VER increased as the checkerboard check size was increased to approximately 56 minutes of arc, and subsequently decreased slightly as the checkerboard check size was increased further still. Figure 6B illustrates the VER amplitude as a function of check size for the infant, as well as the infant's father. This graph illustrates that the maximum VER response was obtained by different check sizes for the infant and the adult. This indicated that the adult was able to resolve a target with finer check size than the infant. Furthermore, a check size four times as great as that eliciting the maximal VER response from the adult was required to obtain the maximal VER response from the infant. Since the father's best visual acuity was 20/20, the VER measurement suggested a potential visual acuity of approximately 20/80, or better, for the infant. This prediction of a resolution capability equivalent to 20/80 or better was consistent with the reports by Sokol,[20,21] and Marg,[22] who also estimated the visual acuity of four month old infants to be between 20/80 and 20/40. In this case, therefore, the VER analysis extended the findings obtained in the standard pediatric oculovisual assessment to include a quantitative evaluation of visual acuity.

B. Physiological Refraction

An evaluation of a patient's refractive status by retinoscopy provides valuable information on the limitations imposed on visual resolution by refractive errors. Optical correction of any existing refractive errors does not, however, predict normal visual acuity since there may be limitations imposed on vision by neural disorders at the retinal level or higher visual centers. The prediction of resolving ability becomes even more problematical when dealing with infants and non-communicating adults. It is possible, however, to determine with greater certainty whether an ophthalmic prescription will improve visual function in non-communicating patients by means of the VER. It is well known that the amplitude and waveform of the VER is influenced by the sharpness of the retinal image,[23] as well as the functional integrity of the macular cortical pathways.[24-26] Thus by monitoring the "strength" of the neural impulses arriving at the visual cortex, one can determine the likely benefit, if any, that a patient will derive from an ophthalmic prescription which modifies the sharpness or stability of the retinal image. Thus a lens enhancing the cortical response would be considered necessary, while a lens either decreasing the cortical signal or having no significant effect on it would be considered unnecessary. The following three cases will illustrate the usefulness of the patterned VER in determining the need for an ophthalmic prescription on a totally objective basis.

Case No. 1: Assessing Ocular Refraction and Binocularity in an Infant

Patient CD, a nine month old girl was brought to the pediatric clinic on referral from the family physician. She had been a healthy child from birth but at three months of age the parents noticed an intermittent esotropia, that was manifest mainly when the child was fatigued or under stress. The infant had been assessed by an ophthalmologist who prescribed atropine drops over a two week period. This provided no relief of the intermittent esotropia and no further action was taken. The ocular assessment of the child showed the external physical health of each eye to be normal. She responsed to an optokinetic nystagmus drum normally. She also passed the Bock candy bead test with either eye with the beads held at 25 centimeters. Fundus evaluation was unremarkable. The strabismus became manifest during the evaluation of binocular function and was approximated to be 30△ by observation of the corneal reflexes by the Hirschberg technique. The eyes were aligned on visual axis with 25 prism diopters using a prism bar. There was no paresis or hinderance to vergence or version movements of either eye. The refractive error was determined by retinoscopy both with and without cycloplegia (1% cyclopentolate hydrochloride) as +2.50 D of hyperopia. With the correction in place, the esotropia was not apparent.

The child was referred to the Electrodiagnostic Clinic for an objective assessment of the effect of plus lenses on visual function. The results of VER testing are illustrated in Figure 7. These records indicated that the VER was recordable but irregular when a checkerboard composed of 14 minutes of arc was used to elicit the VER. When a correction for most of the hyperopia (in "loaner" glasses) was applied bilaterally, the VER improved significantly for the same checkerboard target. This observation indicated that the plus lenses did not impair visual resolution, but rather facilitated the visual process. A similar improvement in the VER was obtained when the patient's attention was directed to a checkerboard target composed of 28 minutes of arc checks. This observation indicated the reliability and repeatability of the findings with the prescription for hyperopia in place. In view of the improved cortical activity resulting from the application of corrective lenses, and the greatly decreased frequency of the esotropia, a prescription to neutralize the hyperopic refractive error in this child was strongly indicated. In a subsequent communication with the parents a few weeks later, they indicated that their child was happily wearing her glasses and the esotropia was eliminated.

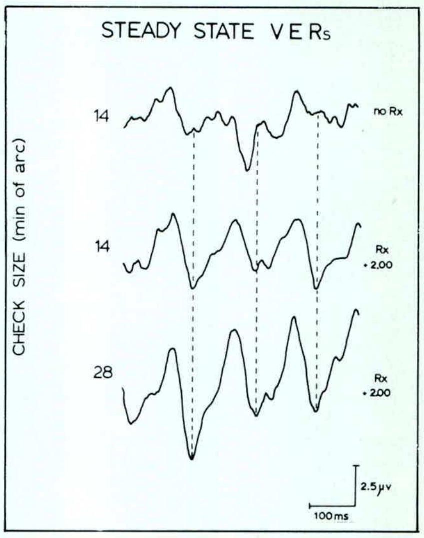


Fig. 7
Steady-state binocular VERs for a 9 month old girl (CB) with an intermittent left esotropia. VERs were elicited by a 12° checkerboard target composed of 14 and 28 minutes of arc black and white checks reversed at a frequency of 8 Hz. Each trace is an average of 50, 500 msec responses. The binocular VER elicited by a checkerboard with 14 minutes of arc checks without a correction for hyperopia (top trace) was recordable but irregular in waveform. This VER waveform was markedly enhanced by the addition of +2.00 DS to each eye (middle trace). Doubling the checkerboard check size increased the amplitude of the VER still further (bottom trace), thereby confirming that the previous response was not spurious and that afferent neural signals to the visual cortex were enhanced by the lenses neutralizing the hyperopia measured by retinoscopy.

Case No. 2: Evaluating the Potential Benefit of Ophthalmic Lenses for Children with Learning Problems

Patient FM, was a seven year old boy whose mother reported him in good health. The teacher in school requested that he be evaluated for vision, hearing, allergy tests and psychological aspects as he was behind his class peers academically. Examination revealed that his visual acuity, ocular motility, accommodative amplitudes and facility, external and internal ocular health were all normal. The refractive error determined by retinoscopy was +1.25 DS, OU. The patient's habitual distance and near phorias were 1△ and 2△ esophoria respectively. The addition of a +1.00 DS changed the near phoria to 4△ of exophoria. Perceptual testing showed the child's responses as being quick, accurate and well within normal limits. There was no indication from the maternal or teacher's history of an abnormal reading posture, or any of the signs and symptoms of accommodative or convergence failure. With the modest hyperopic error which shifted a small esophoria at near, it would be rational to try a lens application and have the parents and teachers observe if classroom behavior was altered in a positive direction. However, with a VER capability, one can be more informed before such a decision is made since visual cortex responses must form the basis for visual perceptions. Therefore FM was referred for an electrodiagnostic evaluation of the necessity for the correction for a modest amount of hyperopia.

The results of the electrodiagnostic assessment by means of the VER are indicated in Figure 8. The VER records obtained monocularly and

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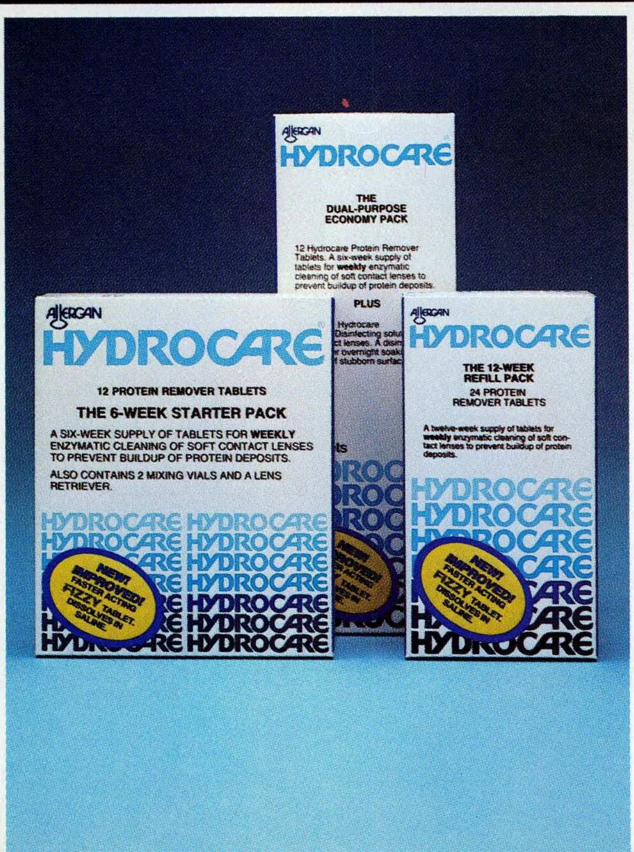

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binocularly, with and without the correction for hyperopia were very similar in waveform and amplitude. Since the cortical input was not improved when the patient's hyperopia was neutralized, it was concluded that glasses would not be beneficial for this patient.

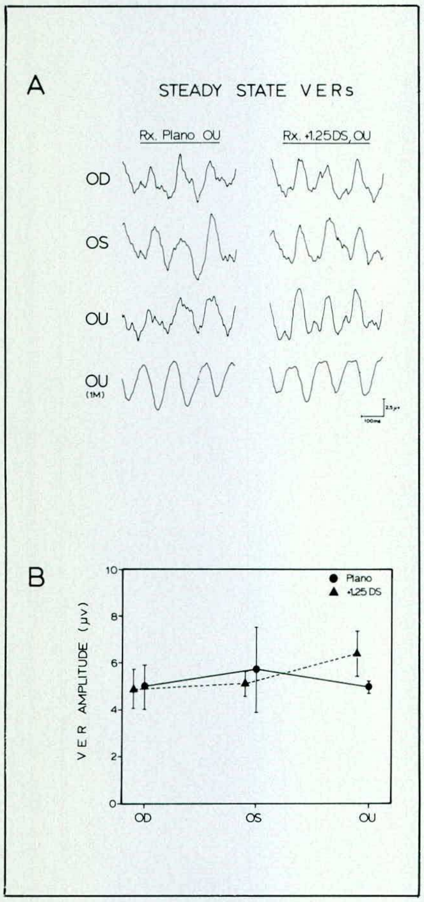

Fig. 8

A) **Steady-state VERs for a seven year old boy, FM elicited by a 6⁰ checkerboard target composed of 14 minutes of arc checks reversed at a frequency of 8 Hz. Each record is the average of 50, 500 msec responses. Monocular VERs with or without a correction for low hyperopia (+1.25 DS) were approximately equal in amplitude and had similar waveforms. Binocular VERs appeared marginally sharper and larger when the patient wore a correction for hyperopia. When the VER target was located at a 1 M viewing distance, the binocular VERs were similar in waveform and amplitude with or without the correction for hyperopia.**

B) **Graph showing the average amplitude the peaks in the steady-state VERs elicited under monocular and binocular conditions, with and without a correction for hyperopia. The vertical bars through each data point are +/-1 SEM for VER amplitudes. This graph illustrates that there was no statistically significant improvement in the VERs when the patient's hyperopia was corrected. Therefore, a prescription for hyperopia was not indicated.**

Case No. 3: Assessing the Benefit of Glasses for Low Hyperopia

In direct contrast to the results of the electrodiagnostic assessment obtained for the patient described above, the following case illustrates that visual function was improved in a 7 year old boy (DM) by correction for a modest amount of hyperopia. Patient DM demonstrated good ocular health and good ocular motility with a low esophoric condition at 40 cm.. The esophoria (4 prism diopters) was completely neutralized with a +1.0 DS correction for hyperopia in each eye. The results of the VER testing for this patient are shown in Figure 9. Monocular and binocular VERs without a prescription were seen to be of nearly equal amplitude and waveform. However, application of the correction for the modest amount of hyperopia greatly enhanced the binocular VER. In view of the improved cortical response when the patient wore the correction for hyperopia, a prescription was given to the patient to be worn for all near-point visual tasks. A re-examination one month after receiving his glasses indicated that the patient showed a distinct preference for wearing his glasses whenever he was required to do near-point visual work such as reading or writing. This type of purposeful behaviour in this patient who was born with mild cerebral palsy was interpreted as indicating a facilitation of the visual process derived from wearing the glasses.

C. Objective Evaluation of Binocular Function

In addition to determining the efficacy of an ophthalmic prescription in improving visual function at a neural level, the binocular VER can provide an indication as to the quality of binocular co-ordination.[27] The following three cases illustrate various aspects of binocular function that can be evaluated objectively by the binocular VER.

Case No. 1: Evaluation of Binocularity in High Ametropia

A three year old non-communicating girl (BS A) was brought in for an oculovisual assessment largely because of a turned eye. The examination revealed a large angle alternating esotropia that was manifest at all observation distances. Ocular refraction indicated a high hyperopic refractive error in each eye (OD +9.00 -0.75 X 157, OS +8.25 DS). As the patient refused to provide any verbal indication concerning the status of her vision, she was referred to the Electrodiagnostic Clinic to determine whether the correction of the hyperopia detected by retinoscopy would provide an improvement in visual function both in terms of visual resolution and binocularity. The results of the electrodiagnostic assessment are shown in Figure 10. The VER records obtained under

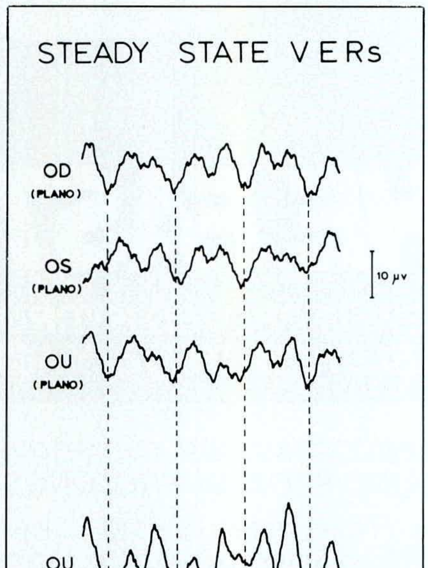

Fig. 9 ▶

Steady-state VERs elicited from a seven year old boy, DM, born with cerebral palsy. The VER recording parameters were the same as those described in Figure 7A. The VER waveforms were slightly irregular because of poor patient cooperation. No significant differences were noted between the monocular and binocular VERs without glasses for low hyperopia. However, a very significant enhancement in the binocular VER was noted when a correction for hyperopia (+1.00 DS,OU) was applied. In this case, a prescription to neutralize the hyperopic refractive error was strongly indicated.

monocular and binocular viewing indicated a very significant enhancement when the correction for hyperopia was worn. However, the VER for the left eye was distinctly smaller than that elicited for the right eye. In addition, as is illustrated in Figure 10B, the peaks in the VERs elicited for each eye were approximately 90° out of phase. Under binocular viewing conditions, the VER closely resembled the VER obtained for the right eye. This neural response suggested that the left eye likely had inferior vision to that of the right eye. Furthermore, since the binocular VER resembled the VER obtained for the right eye, there was a strong possibility that the left eye was suppressed in binocular viewing conditions. The result of this electrodiagnostic assessment prompted the initiation of amblyopia therapy for the left eye together with a prescription for the entire amount of hyperopia as detected by retinoscopy. A follow-up evaluation of the patient's visual performance after she wore her glasses for approximately a 6 month period revealed improved VERs for the left eye, and a significant reduction in the phase difference in the monocular VERs.

Another follow-up examination 6 months later, revealed that the eyes were almost always straight, and that the amplitude and waveform of the VER had improved. This was interpreted as indicating continued improvement in visual function which at the time of the second re-examination still could not be verified subjectively. The parent did report, however, that there were no apparent visual or motoric problems with the glasses, and that the patient assumed a normal posture while reading or writing.

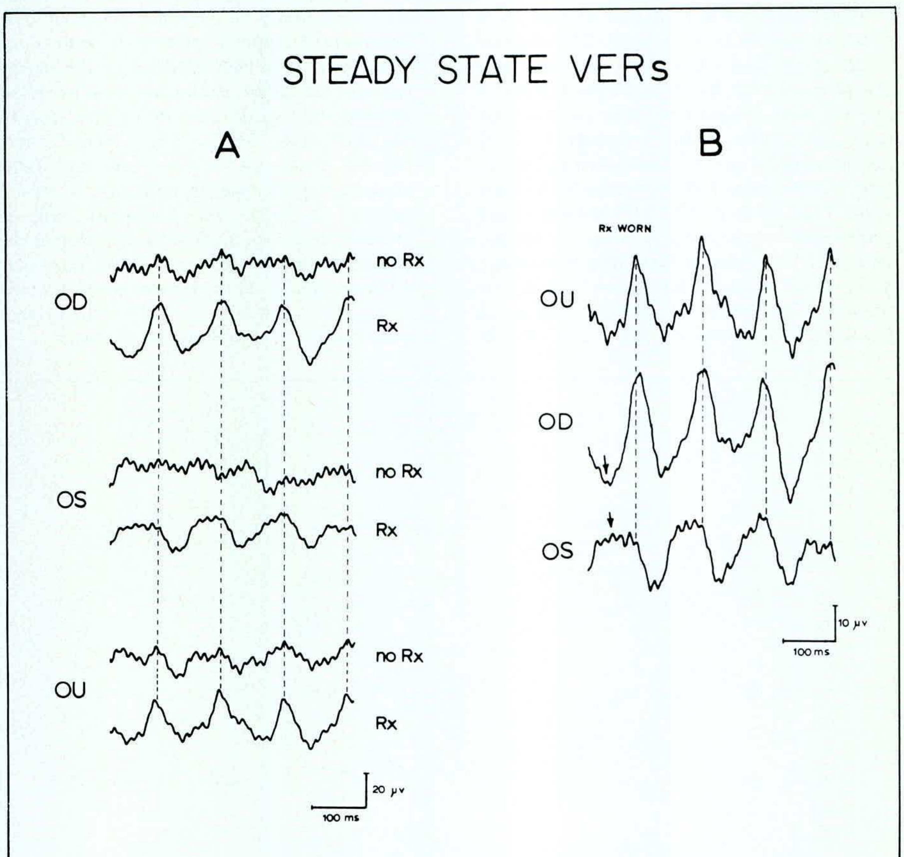

Fig. 10

A. Steady-state VERs for a non-communicating three year old girl with a large hyperopic refractive error and an alternating esotropia of approximately 35Δ at near. VERs were elicited by a 6° checkerboard target with 14 minutes of arc black and white checks reversed at a frequency of 8 Hz. Each trace is an average of 30, 500 msec. responses. An electrodiagnostic evaluation was performed to evaluate the effect of a large correction for hyperopia (OD +9.00 -0.75X157, OS.+8.25 DS) on visual resolution and binocularity. The results indicated that the VER waveform and amplitude was greatly enhanced in each eye by the correction for hyperopia. However, the VER for the left eye was of lower amplitude and had a flatter waveform than the VER for the right eye.

B. Enlargement of the steady-state VERs under monocular and binocular viewing conditions while the patient wore the correction for hyperopia. The vertical broken lines indicated that the monocular VERs were out of phase (see portions of traces identified by small inverted arrows). The binocular VERs were similar in waveform and had the same temporal characteristics as the VER elicited from the right eye. This observation suggested a suppression of the left eye in binocular viewing. A prescription for the hyperopia determined by retinoscopy combined with amblyopia therapy for the left eye was indicated.

Case No. 2: Assessment of Binocularity in the Absence of a Significant Refractive Error

Figure 11A shows the monocular and binocular VERs for a seven year old patient whose oculovisual assessment indicated normal function of all components of the visual system. In this case, the binocular VER waveform illustrates the phenomenon of "binocular facilitation" wherein the binocular VER amplitude is greater than either monocular VER. The occurence of binocular facilitation usually indicates excellent binocular coordination and normal sensory integration of afferent visual stimuli. In contrast to this example where the binocular VER indicates a high degree of binocular integration, Figure 11B provides two examples (type 1 and type 2) of binocular VERs encountered in patients with various degrees of binocular dysfunction. The "type 1" abnormality in the binocular VER is characterized primarily by the appearance of secondary peaks (see small inverted arrows) unrelated to the checkerboard reversal rate. In addition, there may be a slight phase lag in the binocular VERs when compared to the monocular VERs. The "type 2" abnormality in binocular VERs is highlighted by the absence of a regular pattern under binocular viewing conditions, while under monocular fixation the VERs have both a regular waveform and normal amplitude. The specific binocular anomalies that were eventually detected by standard optometric procedures in therse patients illustrating the "type 1" and "type 2" VER pattern were poor ocular coordination for versions, vergences and smooth pursuits in one patient, and uncompensated phorias in the second patient. The case examples provided in Figure 11 therefore illustrate that the binocular VER can be used to glean information concerning the degree of binocular coordination in a pediatric population. Inasmuch as these patients were seen in the Electrodiagnostic clinic prior to a general oculovisual assessment, these examples also illustrate that the binocular VER can be used as an objective screening procedure for detecting binocular anomalies. The occurrence of binocular VERs showing a degraded waveform when compared to that obtained for either eye alone indicates the need for a more detailed evaluation of binocular functions.

D. Objective Assessment of Ocular Health

The functional integrity of various components of the visual system can be assessed objectively by means of the pattern VER. The following examples will illustrate how the VER was used to assess neural function at the retinal level, optic nerve, and cortical levels.

Since the pattern VER is an indirect measure of macular function at the retinal level, it can be used to assess the functional integrity of macular-cortical pathways in patients with ophthalmoscopically visible irregularities in the macular areas. Figure 12 presents the steady-state VERs for three siblings of one family elicited by a checkerboard with check sizes varying from 14 minutes of arc to 112 minutes of arc. The sixteen year old boy demonstrated no abnormalities of visual function, normal appearance of the ocular fundus, and normal VER waveforms in response to all check sizes (VERs in the middle column). The VER responses for the 18 year old girl however were completely extinguished for all check sizes. This patient demonstrated fundus signs resembling Stargardt's disease and was classified as legally blind. With the aid of a 6 x 16 monocular telescope

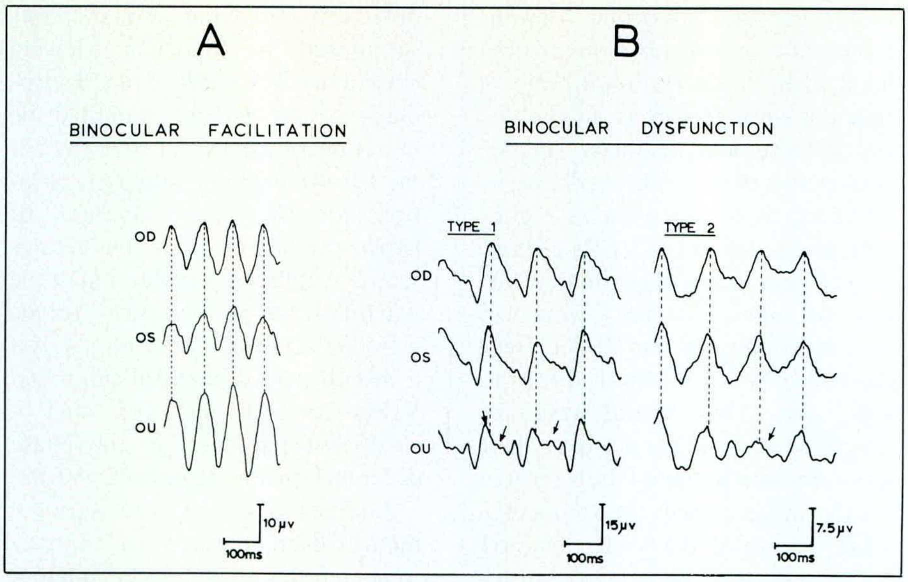

Fig. 11

Steady-state VER responses elicited by a checkerboard target composed of 14 minutes of arc, black and white checks reversed at a frequency of 8 Hz. Each trace is the average of 30, 500 msec. responses. These records illustrate the utility of the binocular VER in determining the quality of binocular coordination. (A) binocular and monucular VERs for a seven year old boy (AZ) with normal visual acuity and binocularity. It is noted that the binocular VER is larger than either monocular VER. This "binocular facilitation" serves as a physiological index of a high degree of binocular coordination. (B) VER records showing two types of binocular VERs indicating some non-specific binocular dysfunction. A type 1 pattern is seen most frequently. It is characterized by the occurrence of secondary peaks (see small inverted arrows) and a small phase shift with respect to the monocular VERs. These records were derived from an 8 year old boy (RS) complaining of reading difficulty. A type 2 pattern is seen less frequently and is characterized by a marked degradation in the amplitude and regularity of the binocular VER waveform. These records were obtained from a 14 year old boy (JP) with a large uncompensated exophoria at 40 cms.

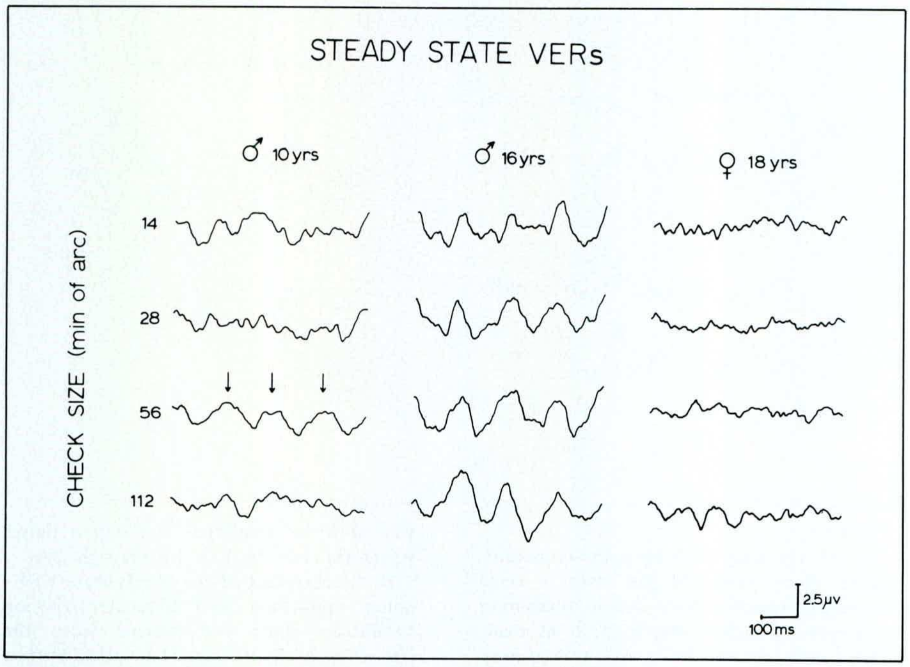

Fig. 12

Steady-state VERs elicited from three siblings using a checkerboard with black and white checks varying from 14 to 112 minutes of arc reversed at a frequency of 8 Hz. The two boys had normal visual acuity (20/20) while the eighteen year old girl had bilateral central scotomas reducing vision to approximately 20/125 in each eye. In her case, the pattern VER was extinguished for all check sizes. The sixteen year old boy demonstrated normal VER waveforms for all check sizes. The ten year old boy demonstrated abnormal VER responses to all checkerboard check sizes except 56 minutes of arc. The irregularity in the waveforms indicated a significant functional disturbance of vision, even though the measured visual acuity was 20/20 in each eye. Ophthalmoscopically, this young boy demonstrated macular features similar to those seen in his sister's eyes.

she obtained a visual acuity level of 20/15. The VERs obtained for the youngest sibling (left hand column) indicated abnormal responses for all check sizes except for those subtending 56 minutes of arc. These findings identified a physiological abnormality in the macular cortical pathways, likely restricted to the retinal level in view of ophthalmoscopically visible abnormalities in the distribution of macular pigmentation. This young boy's maculae were characterized by distinct concentric rings of irregular macular pigmentation (typical of patients having a bullseye maculopathy). It is significant to note that the VERs were abnormal in this young boy's case even with a clinically measurable acuity level of 20/20. These findings, together with reduced sensitivity at all spatial frequencies as determined by contrast sensitivity function (CSF) measurements, suggested one of two possible diagnoses; 1) decreased functional reserves of central vision, or 2) incipient retinopathy. The VER records shown in Figure 12 illustrate several points; 1) that the pattern VER is extinguished in manifest retinal disease restricted to the macular areas, 2) that the VER is useful in providing additional support of a diagnosis of normal visual function in the case of patients with a normal appearance of the ocular fundus, but a family history of retinal disease, and 3) that a suspicious appearance of macular areas may be mistakenly considered a normal variation of retinal pigmentation especially when normal visual acuities are measured.

Retrobulbar disorders of visual function can be identified by evaluating both the retinal and cortical responses to controlled light stimuli. Figure 13 presents the results of an electrodiagnostic evaluation for a fourteen year old boy who claimed only dim light preception in both eyes. Flicker ERGs and VERs were performed simultaneously for each eye with the results indicating normal flicker ERGs but a total absence of light-induced responses at the cortical level. This indicated grossly normal retinal function with a pathological dysfunction of the post-retinal components of the visual system. Although these findings by themselves did not localize the site of the lesion, the combination of ophthalmoscopic observations (pale optic nerve heads) and electrodiagnostic findings made possible a diagnosis of bilateral optic atrophy. Inasmuch as the patient was unable to respond to any pattern stimuli, but was able to perceive light flashes in the peripheral field of view, it was concluded that some of the fibers in the optic nerves subserving peripheral vision remained intact. However, the observation that flicker VERs were completely extinguished indicated that macular cortical pathways subserving form vision were totally destroyed.

The following case illustrates that the pattern VER can be used to access indirectly various cortical structures outside the primary visual cortex. Patient JR, a seventeen month old boy, was brought in for an oculovisual assessment in order to determine his visual capabilities. JR was born without a corpus callosum, and was developmentally delayed. Previous psychological testing determined that JR was functioning at the eight month level. This young boy was able to manipulate large toys, but the mother reported that he could never reach for them directly; instead, he tended to bump into them with the side of his hand and then pick up the toy. In addition, the mother reported that JR tended to look out of the corner of his eyes when attempting to reach for objects. The results of a standard oculovisual pediatric examination revealed normal ocular motility, good ocular health both externally and internally, normal direct and consensual pupillary light reflexes, and low hyperopic

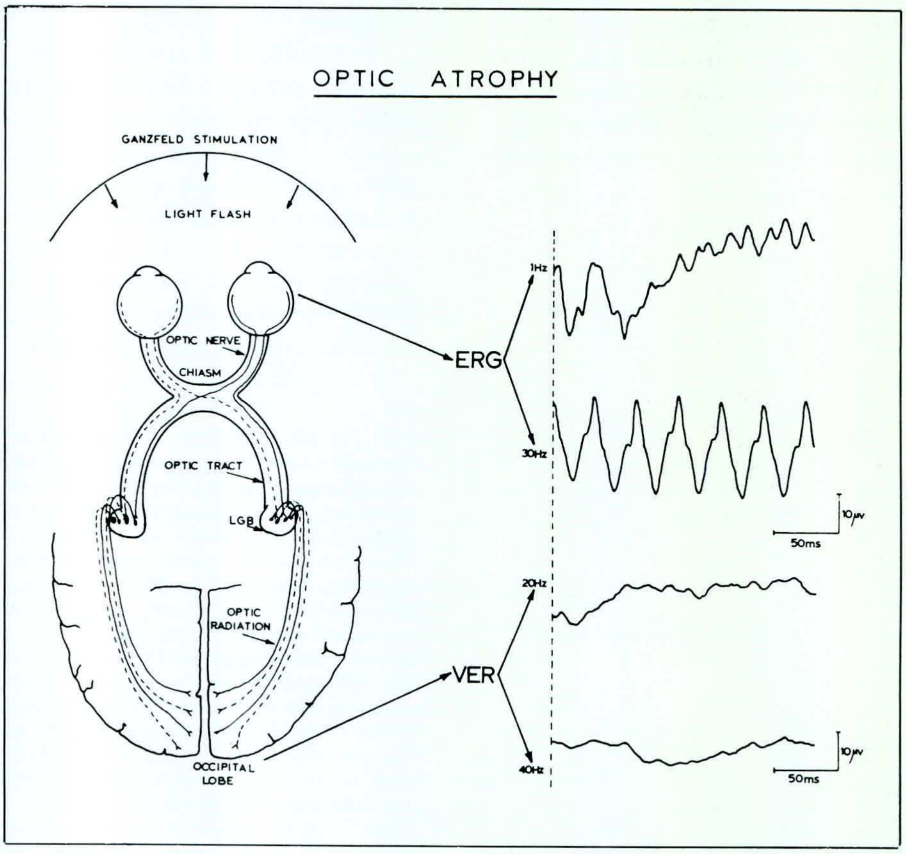

Fig. 13

Figure illustrating how flash ERGs and VERs were combined to diagnose a bilateral post-retinal lesion in the visual pathways. In the case illustrated here, the fourteen year old boy (DB) claimed only dim perception of light. Single flash and flicker ERGs were normal in each eye. However an assessment of macular cortical pathways indicated extinguished flicker VERs for light flashes presented at 20 and 40 Hz. These findings indicated a pathological disorder in retrobulbar components of the visual system subserving form vision. A tentative diagnosis of bilateral optic atrophy was supported by the pale appearance of the optic nerve heads.

refractive errors in each eye (OD +1.50 DS, OS +1.00 DS). JR could not respond to the Bock candy bead test for an approximation of visual acuity. An assessment of visual fields by confrontation did not reveal any gross abnormalities. The patient gave normal jerk-type nystagmus responses for each eye to the optokinetic nystagmus drum, but the left eye gave a noticeably weaker beat. The general conclusion of the oculovisual assessment was that JR was developing normally with respect to his vision, and that glasses were not required. However, because the patient was totally non-communicating, it was not possible to quantify in any meaningful way the degree of visual resolution, or provide an explanation for the unusual visual behaviour reported by the mother.

The results of an electrodiagnostic evaluation by means of the patterned VER are illustrated in Figure 14. The VER patterns shown in this figure are of good amplitude and regular waveform for each eye and under binocular viewing conditions. Noteably, however, the amplitude of the VER for the left eye was considerably reduced when compared to that for the right eye. This indicated that the visual acuity in the left eye was likely inferior to that for the right eye, even though the refractive error as determined by retinoscopy indicated less hyperopia for that eye. Based on the check size used to elicit the VER, a visual acuity of at least 20/60 was predicted for the right eye with inferior vision in the left eye. Most significantly, the amplitude of the binocular VER was greater than either monocular VERs. This indicated that some level of binocular integration occurred under binocular viewing conditions a function that is compromised in patients with corpus calosum lesions.[24] This information concerning binocular function was not obtainable by any other clinical method since the patient was entirely non verbal.

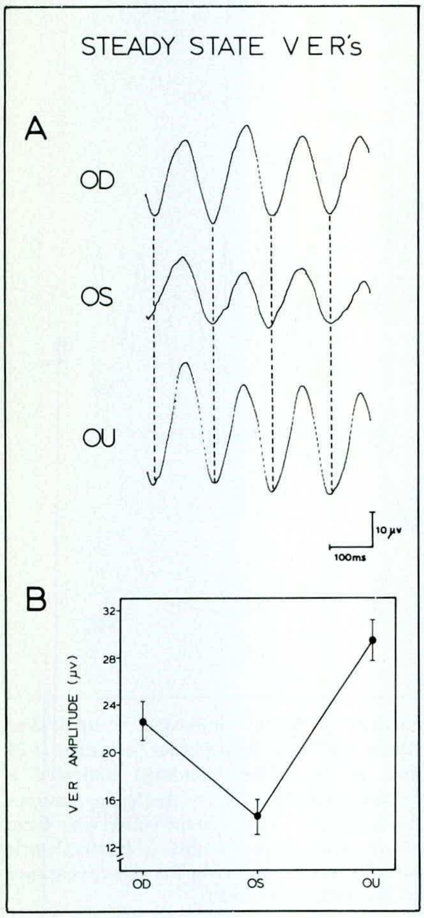

Fig. 14

A) - Steady-state VERs elicited from an eighteen month old, noncommunicating, developmentally delayed, boy (JR) born with an agenesis of the corpus callosum. A 12° checkerboard target composed of 28 minutes of arc black and white checks reversed at 8 Hz was used to elicit the VERs. The VER elicited for the left eye was notably decreased in amplitude compared to the right eye. The binocular cortical response, however, showed some binocular facilitation inasmuch as its amplitude was greater than either monocular VERs. This indicated some degree of binocular coordination, a function which tends to be compromised in patients with complete sections of the corpus callosum.

B) - Graphical presentation of the averaged amplitude of the peaks in the monocular and binocular steady-state VERs recorded for JR. The vertical bars through each data point represent +/- 1 SEM for VER amplitudes. This graph emphasizes that the overall cortical response for the left eye was significantly less than that for the right eye, and that the binocular response was greater than either eye alone.

Discussion

The results of a standard optometric examination usually provide sufficient information for the practitioner to define the visual capabilities and limitations of a particular patient and provide remedial therapy if required. There are instances, however, when in the presence of patient-reported vision difficulties, the results of a fundamental oculovisual assessment do not identify any abnormalities or allow a definitive diagnosis to be made. Such is the case when the optometrist is confronted with malingerers, noncommunicating patients, or cooperative patients providing paradoxical responses in various visual tests.

The primary oibjective of this paper is to make the optometric practitioner aware of the technology that is now available to assess the physiological integrity of various portions of the visual system and help identify sub-clinical visual disorders that may explain a patient's symptoms or identify them as psychogenic in origin. The electrodiagnostic techniques described in this paper illustrate their use in providing information concerning a patient's visual acuity, refractive status, binocular function, and ocular health when these functions cannot be assessed readily by the methods employed in a standard eye examination. The results of these tests are of considerable value in arriving at a final diagnosis concerning visual function in a patient, as well as providing prognostic information on specific visual anomalies. It should be emphasized, that these specialized tests neither have an application for every patient, nor are they likely to replace the diagnostic test procedures currently employed in optometric practice. Instead, these neurophysiological tests are intended to supplement the findings of a thorough oculovisual assessment in aid of a well-founded diagnosis and disposition of clinical cases.

With the passage of time, a greater number of uses for the ERG and VER test procedures described in this paper will likely evolve. The authors have found these techniques extremely useful in providing practical solutions to various visual disorders common to a pediatric population. In addition, these electrodiagnostic techniques have provided new information concerning fundamental aspects of vision physiology and clinical correlates of neurophysiological mechanisms that until now could only be examined in acute animal experiments. The ever increasing pool of knowledge concerning visual mechanisms derived from animal experimentation and clinical studies ultimately provide better diagnostic and treatment procedures for the delivery of vision care services. It is hoped that the information provided in this paper will encourage optometric practitioners to originate, utilize, and develop more fully electrodiagnostic resources accessible to them in the interest of providing a more comprehensive vision care service to their patients.

Acknowledgement

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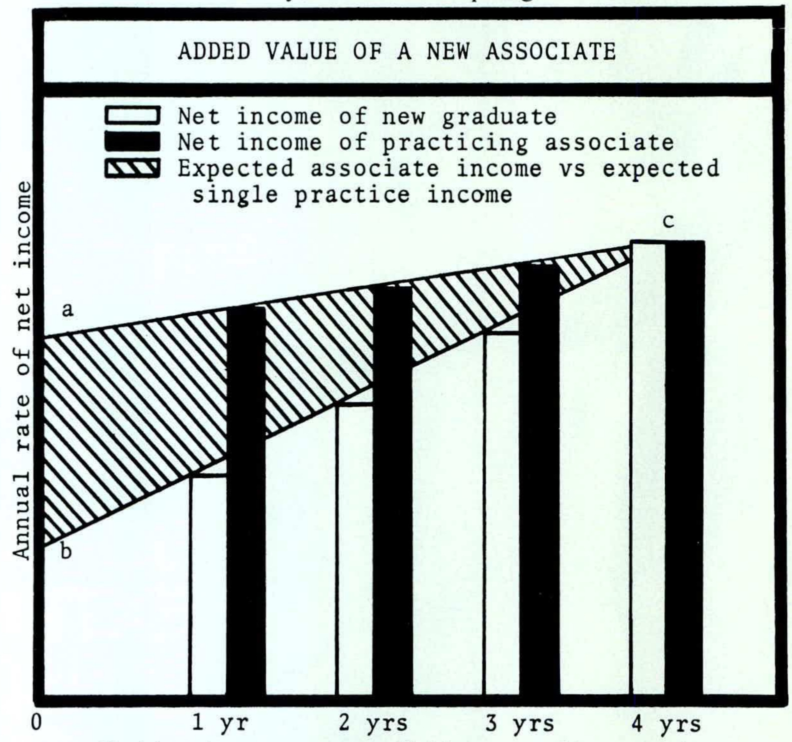
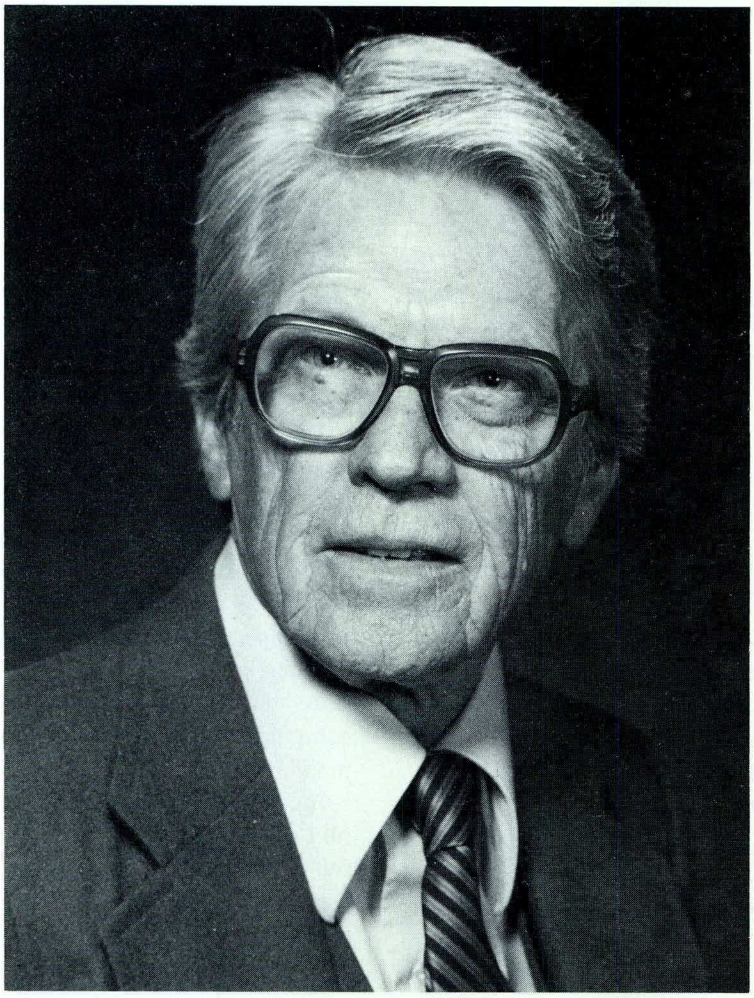
Erratum

In the article, "Goodwill — what is it worth in the market?", which appeared in our March issue (Vol. 45, No. 1, Pp 35-39), the following chart was inadvertently omitted. We apologize for the error.



The triangular area represents added income practitioner expects to earn as associate over what might be earned in own practice.

Dr. C.W. (Clair) Bobier



CJO

At what age did you consider entering optometry and what prompted the decision?

CB

I had an older brother, Tom, who was practising optometry when I came back from overseas after the war. It was while visiting him that I decided to go into optometry. It was a choice of either finish my arts degree at the University of Saskatchewan and go back to teaching school, or make a change to a new profession. I decided on optometry.

CJO

So you were a part of the established pattern — that most of our recruitment came from family connections?

CB

Yes, and I doubt very much that I would have done so, had it not been for Tom, because otherwise I wouldn't have known very much about optometry.

CJO

What was your conception of optometry at that time?

CB

I had a fairly realistic conception of what and where the profession was. I knew, for instance, that it was an emerging profession, that it had an educational program, which wasn't in a university. My brother, being a thoughtful and articulate person, had often talked to me about the advantages, as well as the problems of the profession. I think I was pretty well-informed.

CJO

At that time, the School was located in a very humble situation physically. Did that affect your attitude when the time came to decide?

CB

Oh no! I had been stationed at the University of Toronto for training in radar while I was in the R.C.A.F. It was at the time when my brother was still an undergraduate at the College. So there were many occasions when I could visit Tom and his wife, Bess, and meet their friends, most of whom were optometry students. I also saw the old buildings which had been converted, after a fashion, to house the College. Believe me, I wasn't at all impressed with the buildings, but I was with the students that I met.

CJO

At that time, Dean Thompson was the mainstay at the school. What recollection do you have of him, and what influence did he have on you?

CB

I liked Dean Thompson. He was an important figure in Canadian optometry — he was the first Dean of the College, which began in 1925 — and I enjoyed his lectures. He was, I think, the one faculty person at the time who had a reflective and philosophical approach to affairs including vision, optometrical education and the whole practice of optometry. I remember that he often digressed from the subject matter at hand to recall some relevant experience. I used to enjoy those little excursions he took us on, always with a twinkle in his eye.

CJO
He had an M.A. in Physics and Mathematics.

CB
Yes, he was certainly competent in those areas. Surprisingly, he had developed a fair knowledge of the visual processes without any benefit of formal training in Physiological Optics, without any budget. I had a great respect for him.

CJO
Did he have any influence on your later decision to join the staff of the College?

CB
Not directly, no. Not as much as did Ted Fisher and Bob White. That decision actually came later, after Dean Thompson's death. As for Dean Thompson's plans for staff, I can't really say; but I suspect he was looking for leadership in some of the more outstanding people in our class, some of whom were obviously leaders and go-getters, but I don't recall any conversations with him on the subject.

CJO
You mentioned that Dean Fisher had a greater influence.

CB
Yes. Ted had taken over the Deanship immediately after Dean Thompson's death in 1948, and he immediately set about making plans for future staff. He knew that I had had several years of teaching experience, and he also knew that I was interested in setting up a vision training clinic at the school (They didn't have such a clinic at this time). Of course, I couldn't offer him any experience as to how such a clinic should operate and he couldn't offer me a salary. We were both gamblers, I guess, and so we took the chance with each other. I spent three mornings a week, that first summer, at the College, seeing cases of strabismus. I was also instructing in applied optics. Looking back, I believe I was very fortunate to have had that opportunity.

CJO
Since you graduated in 1948, you would have had Dean Fisher for only a short time.

CB
True, but that's as Dean. Don't forget that before Ted became Dean, he was giving courses in clinical optometry. His lectures were always well-prepared and he was enthusiastic about the subject. All of us learned a great deal from him.

CJO
Did any of the other faculty at the time leave any strong impressions?

CB
Well, Dr. Sparks was a wonderful physician and teacher. I liked the way he conducted his classes. He wasn't condescending in any way, and he demanded a lot from us. We were always well-prepared when we went into his class. We had to be. His lectures were always early morning, never later than eight o'clock — sometimes earlier! — after which he made his hospital rounds. He was a wonderful man, really. We respected him as a teacher, but he also became our friend, — and many of us became his patients. Dr. Sparks contributed a great deal to the education of optometrists in Canada.

There was also Dr. Richmond who was, for us, another beloved character. He was a bit rough in manner, a bit demanding, and a bit of a tyrant, too, I suppose. But I don't mean that in an unfriendly way. It was just that, in his class, he alone ran the show. He was never less than meticulous, which made things awkward for most of us, and yet he remained very popular with us. I don't think anyone ever graduated from his classes in geometrical and physical optics with anything less than complete respect for him, and for optics.

CJO
The course in optometry was constantly evolving during the time prior to your arrival, and even subsequent to your graduation. Of the various subjects taught, which did you consider the most important to a career in optometry at that time?

CB
I never had any difficulty realizing that there were a few core subjects that were highly relevant to the program in optometry and that, without these, you couldn't understand the nature of what optometrists do, and attempt to do, for their patients. Without these core subjects, you would have a very flimsy foundation for your professional judgements. As I recall, I never had an aversion to optics, or a feeling that mechanical optics, as we termed it then, or indeed any aspect of applied optics, wasn't essential to my education as an optometrist. The same thing applied to studies in anatomy, neurology and physiology. I always found studies in physiological systems intriguing, especially those concerning the brain's function.

I don't know quite why I'm saying this, but I guess I'm responding to a few of my experiences with former students, some of whom seemed to abominate optics and physiological optics, including studies in perception. It seemed as though they were confused on what the real worth of such subject matter was to the practice of optometry. I was fortunate in that I never experienced this problem; nor did I ever have a problem in understanding that we needed a sound basis in ocular pathology. Now, obviously, this is a very important subject for the optometrist. But I object to an over-emphasis on ocular pathology at the expense of other, equally-important subject matter. It's a recent development and, fortunately, is found only in a few schools, where more and more medicine is being taught. But we certainly didn't have this problem in my day.

Another problem we *didn't* have was whether or not optometrists should treat some types of ocular disease. I think the question has arisen because optometric education in pharmacology has become more sophisticated, and it is apparent to optometrists that many of these cases can be safely and simply treated by drugs. So the question arises: Why not treat these cases? I think this would be a great mistake, for several reasons, but two of which are paramount. First, the Health Disciplines Act doesn't permit such practice and, secondly, if optometry chooses to go that route, it can only do so by sacrificing a large part of its present expertise to gain expertise in the field of medicine. What a loss this would be, particularly from the patients' point of view! Fortunately, though, this doesn't seem to be a problem in Ontario.

CJO

Given the curriculum at the time when you were a student, and the curriculum now, would you still place the same emphasis on the programs you have discussed, — optics and applied optics, physiological optics and ocular pathology?

CB

Yes, but to them I would add pharmacology, which wasn't even a part of the program thirty years ago. The important thing in creating a curriculum is balance. It should be as balanced, say, as the one we established here at Waterloo in 1967. Some of it was modelled after the curricula at leading American University Schools of Optometry such as Ohio State, Indiana and Southern California. We owe a great deal to such men as Professors Fry, Hofstetter and Morgan. Much of the curriculum, however, was a continuation of that which had evolved through the years 1925 - 1967 at the College of Optometry of Ontario.

CJO

Do you subscribe to the theory that the essential difference between professions is not so much what they study, but rather what they do with their knowledge after they graduate?

CB

I would agree with that, but only in part. I think the curriculum does make a difference in what is practised. People tend to do what they have learned best. Sometimes, however, what is done in practice is dictated by factors other than the curriculum: by such forces as economic pressures, time pressures, the kind of health insurance that is in a province, and so on. The degree of sophistication in the public's understanding of what constitutes good quality health care is another determining force. All these affect practice. My own hope is that the kind of optometric practice that exists, as a model to students, in our teaching clinics, will divorce itself from that which exists in practice and embrace something more ideal.

I think optometric curricula and programs in clinical optometry should be put together by people who understand practice and respect it, and at the same time, understand and respect vision science and the new technology now available to those providing vision care; in other words, by very wise men and women.

CJO

When you graduated in 1948, you had taken many of your courses at the University of Toronto, courses in anatomy, physiology, optics, calculus, psychology and so on. Through a student's eyes, — what was your impression of these subjects?

CB

As a student, I thought that, for the most part, they were excellent. Prior to the war, I was enrolled at the University of Saskatchewan, so I did have some feeling for a university's program in arts and science (at least from a student's point of view). But, at Toronto, who wouldn't have been impressed by people like Richmond (Optics), Cates (Anatomy), Stanton (Mathematics), Langford (Zoology), Neal (Comparative Anatomy), Mott (Psychology) and Inns (Economics) to name some of them?

Looking back as a professor of physiological optics, however, I can see some of the shortcomings of the program. While the courses were basically good in themselves, vision content *per se* was lacking. For instance, we had very little optics, as applied to the eye. Our calculus didn't include derivations of optic formulae, or how to apply calculus to problems in eye kinematics. The psychology labs included some visual perception, of course, but didn't, for example, explain or even touch on the distortion of one's visual space that is frequently associated with ordinary spectacle corrections. Because the University of Toronto lacked a Department of Physiological Optics, the courses given to optometry students were something less than ideal.

CJO

Do you recall the circumstances surrounding the University of Toronto's decision to cease providing programs for optometry students?

CB

I certainly do have some recollections of that difficult period. At the College, we were very upset because it meant that we immediately had to make a major adjustment in our program. We had to find new staff and teaching facilities to fill the gap, and in such a way that optometrical education did not suffer as a result.

At the time, we felt that those in the University of Toronto who opposed the idea of the University's providing education for optometrists (and there were some) had been able to defeat us. However, I think now it is probably more realistic to view it as a decision taken by the University as part of its great post-war expansion, which put on tremendous pressures for additional space and facilities. Our claim on these as a College, outside the University, was definitely not as great as that of any of the departments inside. This, at least, was the reason given at the time by President Smith.

CJO

In retrospect, did the decision have a good or bad effect on optometric education?

CB

In the long term, I am certain it had a very good effect. It forced us to develop a program of our own which, in the end, proved much more effective. The fact is, you can't expect a professor of optics or anatomy or physics, who likely knows very little about the practice of optometry, to understand the special educational needs of optometry, not as well as someone in the profession.

We were suddenly in the position of having to do it ourselves. Mind you, it put great pressure on us and, at times, we were stretched pretty thin. I can remember, for example, introducing some pharmacology in a course in physiological optics and the difficulty I had in spelling, never mind pronouncing, the names of some drugs. However, a few years later, we were able to get the services of Dr. Lyle, and the hurdle in that particular area was cleared quite nicely. All in all, I think we were much better off than we would be had we retained the particular association we had with the University of Toronto.

CJO

We understand that you were the first to receive financial support from the College of Optometrists of Ontario to do graduate work in Physiological Optics.

CB

Yes. It became obvious, when Bob White resigned from the staff, that we needed someone with special knowledge in this field. White, actually, was the first member of our staff to become acutely aware of this particular deficiency in our program and he personally did a great deal to make up for it. I remember that he read and digested most, if not all, of Helmholtz's *Physiological Optics* in one summer. I'm sure that he was the first person in Canada to have a comprehensive understanding of the subject.

As you might expect, not all of his students were interested, at the time, in the perception of visual space. But Bob was an excellent teacher, a great friend, and I've always regretted that we lost him. You must remember, however, that the College's financial resources at this time were very limited. There was no government money, and optometrical education was financed by the students' tuition fees ($700.00 per year) and the licence fees of about 450 Ontario practitioners ($25.00 per year). There were no sizeable individual donations, either, such as there are now. With only that income (less than $100,000.00), the Board of the College had to carry out the regulatory functions of the College, and provide the educational program as well.

It was at this time that the great managerial skills of Irving Baker and Ted Fisher came to the fore, a fact which I didn't always appreciate fully, since their skills seemed to have a deleterious effect on my salary. No, I'm joking! I always knew that they were giving me all that was reasonably possible. Of great help was the fact that we always had a number of Toronto optometrists who came in week after week, year after year, as volunteer clinical instructors. They received no remuneration for this, and travel money was never discussed.

So when Bob White left, we faced another hurdle. Irving Baker was President of the Board at that time, as well as being the Clinic Director, and the two of us discussed the problem many times with Dean Fisher. Finally, I decided to take graduate work if I could get help in financing it. I still had a practice. I had a young family (Paul was a small baby, and I was 40 years old). I left for Ohio State on September 4, 1954.

It all seemed a bit crazy at the time. Professor Glen Fry at Ohio State got me a teaching assistantship, and the College provided much of the rest that was needed to look after the family at home.

Well, in spite of the loneliness of being away from my family and the very long hours of study and work that I had to put in, in order to cope with the situation, I have to say in retrospect that it was a very rewarding and stimulating experience. I count myself extremely fortunate to have had Fry as my supervisor. Not only did the man possess a formidable knowledge, but I shall never get over the great example he set for his students. He usually worked at a drafting table in a corner of the machine shop when he wasn't making something in the shop. (He is an excellent mechanic, by the way; a good draftsman, and he was always calculating and designing optical apparatus and, of course, carrying out research.) There never seemed to be enough time for him and no matter when you left the school, Fry's light was usually still burning at midnight or two o'clock in the morning, sometimes even later! He's a quiet man but, in a social situation, he shows very good manners. I was absolutely awed by him, more so, I think, than by any other person alive.

In June, 1955, I returned to Toronto and prepared for the Fall and Winter courses at the College. Then, in the spring of 1956, I went back to Ohio State for the summer quarter and finished my Master's degree.

As it turned out, our being able to provide for the first time a more or less comprehensive program in physiological optics was an important turning point. Students who graduated in optometry from the College were now, for the first time, in a position to apply for graduate work. And in a few years' time, a string of graduates like Marvin Lunsky (M.S.), Marvin Langer (M.S.), Arnie Remole (Ph.D.), Bill Lyle (Ph.D.), Emerson Woodruff (Ph.D.), George Woo (Ph.D.) and David Williams (Ph.D.) were available to the College and, subsequently the University of Waterloo.

So, in summary, I think the action taken by the College at the time was farsighted; and that vision science in Ontario, as a result, was given its first big boost.

CJO

We see the new building as not just a building, but a concrete expression of optometry's efforts. But it must have presented many problems, — its planning, its construction, its funding. As the "designer" to some extent, do you have any thoughts on the culmination of all this effort?

CB

As building chairman, I was in a position of advantage: right in the centre of things. It was a wonderful experience for me. The true designers were the architects, of course, especially Mr. Hadley and Mr. Freeman. They were great to work with, and they discussed their designs with us and listened to our opinions. As Chairman, I also had a great deal of support from the rest of the faculty, particularly from Drs. Fisher, Woodruff, Long, Lyle and Beauchamp. We had countless meetings concerning the building and I had to meet daily with various members of Physical Plant and Planning as it was then called, and with various contractors. It was a very busy time, but it was also a very exciting one for us. And as for the culmination of all this, — well, imagine after 50 years of "make do" housing, of inadequate and often inappropriate space, not to mention the anxiety of not knowing where we would be in the future. Imagine us having a home at last, brand new and a very beautiful one at that. We were both grateful and proud, and we remain so. I think that is why the University of Waterloo sometimes finds us exceedingly possessive and touchy about this optometry building, acting as if we as faculty, staff, students and practitioners really think we own it. I suppose we do act that way. It would be difficult for us not to, and I expect we always will. At least, I hope so.

CJO

We would just like to ask you, at this point, another general perception type of question. Do you consider it to have been an advantage, or a disadvantage to have been in private practice before you got into teaching?

CB

I'm sure it has had a very definite advantage, although I'm not sure that it has to be private practice necessarily, as your question suggests. Experience in practice and instruction in a first-rate teaching clinic would suffice as well, for example, or possibly better. In any case, I think you must practise for a significant period of time so as to understand what practice is; to know its methods, its demands, its pitfalls, disadvantages and so on. You have to get to know your patients, and only by practising can you do that.

I don't believe, however, that one needs long years of practice to gain the knowledge that is essential for good clinical teaching and the administration of programs in optometrical education. I don't believe, for instance, that ten years' practise experience is twice as good as five years in practice. In fact, I think longer periods of practise can actually be disadvantageous unless, of course, good continuing education programs are available and the practitioner works conscientiously to take advantage of them.

The real challenge for both the practitioner and the professor of optometry is to learn most of what is known about vision and vision care, and how to apply it to the patient's best interest. Fortunately, in spite of the many complexities of the visual system, it is still possible (or very nearly so) to attain such a comprehensive understanding. This is what makes the practice so challenging and, at the same time, so satisfying. With care and effort, the optometrist can be a true eye and vision specialist, unlike physical science or medicine, for example, where the subject matter is vast and where the degree of knowledge has outrun the capability of any one individual to comprehend it all. Of course, as vision science and its technology continues to unfold, this will become more and more difficult for optometrists, too.

CJO

Does the clinic here at the school give you that understanding? It is, after all, a somewhat sheltered environment and you're not out "in the world", if you like, in an actual private practice environment. Do you think the clinic is satisfactory as far as giving an optometrist practical experience?

CB

It goes a long way, but there is still much than can be accomplished. First of all, it is obvious that the kind of knowledge and skill we've been talking about cannot be obtained in *any* undergraduate program. There just isn't time enough. What the program can, and must, do is to set the stage and provide a solid foundation for the practitioner to build on. After that, it's up to the practitioner and the optometric educator.

To answer the second part of your question as to whether I think the clinic at the school at Waterloo is providing satisfactory practical experience, it is clear to me that it does; otherwise, our graduates would not be able to go out into private practice and succeed as they do. Now, if you are also asking, do I think the practical experience could be improved, I would answer yes to that as well.

I think it should be broadened and made more rigorous. For instance, patients could be screened for cases that show extraordinary vision care needs. The need may be in one or more of several areas; in refraction, for instance, or binocular vision, or low vision, or ocular health, or the application of spectacles or contact lenses. These patients should then be examined in depth by the most experienced and knowledgeable clinicians. Students would participate by observing, and by aiding the clinician in working up the case for formal presentation by the clinician, or a student, to the study body and faculty.

This kind of critical peer review situation would be of great benefit and would provide an opportunity for anyone who has anything worthwhile and concrete to contribute. The process of providing special care of this kind might take several weeks, or even months, but it would be most beneficial to the patient and, best of all, it would provide practical experience for most students and faculty in dealing with difficult and rare cases. This kind of experience is not available to many students at present, or to all of our clinicians, for that matter.

Of course, this takes time and effort. (That usually means money, doesn't it?) But then, we must think of the benefits to clinical practice and to education. I don't mean to say that this sort of peer review by students and, more particularly, by faculty, *isn't* being applied in our clinic; rather, that it can be improved and made more rigorous. There is only so much to learn about providing routine vision care and, once a student has more or less mastered this kind of practice, he or she should be made to concentrate on the other-than-routine type of vision care. After all, it is only by meeting the challenge and overcoming it that improvement in clinical care comes about.

University of Montreal School of Optometry Accredited

The American Optometric Association's Council on Optometric Education has officially accorded the School of Optometry, University of Montreal, full accreditation status for an initial period of five years.

This means that O.D.'s graduating from the school will now be officially eligible to write certification exams in any province in Canada, and any state in the United States.

The School's Director, Dr. Claude Beaulne, said in a recent interview that he was extremely pleased by the Council's decision. The choice now available to Montreal's optometric graduates will be of immense benefit to them, to the School and to the profession in both Canada and the United States.

The Effect of Induced Prisms in Haploscopic Measurement of Fusional Limits

D.D. Sheni*

Abstract

When the haploscope is used to measure fusional limits at near, a -2.50 D lens is placed in a lens holder in front of each eye of the subject. It is assumed that the lines of sight will rotate equal amounts to the movement of the haploscope tubes such that the foveal fixation is maintained. This assumption is investigated. It was found that the lines of sight of 60% of the subjects studied lagged behind the movement of the arms of the haploscope. The implication of this is discussed and it is recommended that the haploscope be used as an instrument to train fusional vergences rather than to measure them.

Abrégé

Si le haploscope est utilisé pour déterminer l'amplitude de la fusion de près, on doit interposer une lentille de -2.50 D devant chaque oeil. On s'attendrait que les axes visuels suivraient les angles de rotation des tubes de l'haploscope afin de maintenir la fixation sur la fovéa. Cette hypothèse est l'objet de ce travail. Il a été révélé que dans 60% des cas étudiés leurs axes visuels étaient en retard sur la rotation des bras du haploscope. On discute des effets possibles de ce retard. Les auteurs concluent que le haploscope est un instrument de réhabilitation et non pas un instrument diagnostique.

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Introduction

In binocular vision, the fusional limits of a subject are determined by means of prisms or haploscope. The Risley prisms are employed mostly in routine clinical practice, and the haploscope is occasionally used. When the prisms are used, the phoropter field stop is sometimes displaced, and the subject experiences an early break in fusion. This was studied by Remole and Sheni,[1] and they recommended that the phoropter P.D. be decentered for higher base-out prisms in order to avert this limitation. When a haploscope is employed in measuring the fusional limits, a similar but different situation occurs.

At a distance, the arms of the haploscope are rotated to create retinal disparity, and the lines of sight are assumed to rotate equal amounts behind the tubes such that foveal fixation is maintained. The negative and positive blur and break limits are then measured.

At near, however, the situation is slightly altered. To simulate 40 cm working distance the - 2.50 Diopter lens is placed in a lens holder in front of each eye, and it is expected that the eye would accommodate 2.50 Diopters and converge appropriately due to accommodative convergence. To compensate for the convergence, the arms of the haploscope are set 15 prism diopters convergent. The findings of the limits of single binocular vision are measured from this reference point, subtracting 15^{Δ} in convergence and adding 15 prism diopters for divergence. During the measurement of fusional limits, the eyes are expected to move equal amounts to the movements of the arms of the haploscope. Usually, the lines of sight then intersect at or near the optical centres of the lenses, and no oblique aberrations occur. However, in some cases, one or the other of the following happens; (a) the eyes lag behind the movement of the arms of the haploscope, (b) the eyes move faster than the arms of the haploscope and (c) the eyes alternate between fast and slow movements. Usually the conjugate movements of the eyes are less than the movements of the arms of the haploscope (refer to figure 1). When this occurs, base-out prisms are induced. This results in a lower-scale reading of the arms of the haploscope than ideal. The other thing that happens when the eyes look through the periphery of the lens rather than the center is the influence of aberrations on the retinal image. Oblique rays become more prominent and oblique aberration influences the retinal image by decreasing the sharpness of the image. The result is that the subject perceives blur earlier than he or she should. If, on the other hand, the lines of sight move faster than the arms of the haploscope, a base-in effect is induced. The effect is that a higher than ideal base-out finding is recorded. Oblique aberrations would still play a similar role by influencing the perception of blur. This is only an occasional occurrence. The situation where the same subject alternates between base-out and base-in induced prisms during the same measuring period is very rare. One of the problems that occurs when a subject has high vergence limits is that a break is not experienced before the arms of the haploscope lock together.

It is the aim of this paper to investigate the influences of the above-mentioned factors on the fusional limits of subjects.

Methods

Ten (10) subjects, ranging in age from 20 to 32 with an average age of 23.3 years, participated in the study. Their refractive states are as shown in Table 1. All subjects had visual acuities of 20/20 or better in each eye with their best correction on. A Curpax 5000 Synoptiscope was used in this study and the findings were taken for an optical distance of 40 cm. The arms of the haploscope were adjusted for the near interpupillary distance of the subject and set 15 Prism Diopters convergent. The synoptiscope was set up such that the minus 2.50 Diopter lenses were suspended on a horizontal bar supported by two vertical rods. This arrangement made it easier for the lenses to be decentered with the rotation of the arms of the haploscope. In this way the lines of sight always passed through the optical center of the lenses. The findings were first taken conventionally, and then by decentration of the lenses. During the conventional measurements of the fusional limits, the subject sat comfortably, looking through the tubes as disparity was introduced. The subject reported a blur that could not be cleared and a break that did not permit fusion temporarily. Each haploscope field was supplied with a vertical row of 20/30 Snellen acuity letters which had been photographed and printed on transparent plastic sandwiched between two pieces of glass.

The positive limits of single, clear binocular vision were determined and then those of single binocular vision. For the most of the subjects, the findings were determined conventionally and then by decentration of the lenses. To control training effect, the procedure was reversed for subject C.T. When the subject wore a prescription at the spectacle plane, this was combined with the - 2.50 D lens. For example, subject C.K. needed about - 6.00 Diopters in both eyes; this was combined with the - 2.50 Diopter lens and a - 8.50 D lens was placed in the lens holder.

Table 1 Subjects' Refractive Status

Subject	Spectacle Correction (Diopters)	Subject's I.P.D. Far/Near (mm)	Base-out Findings Blur Break (Prism Diopters)
D.W.	2△ Exophoria @ 40 cm	65/61	7/14.8
	OD PL-0.50 x 137 OS - 0.75 (Glasses)	Age = 21 yrs.	9.4 / 19.4
C.P.	1.5△ Esophoria @ 40 cm	59/55	14.8 / 21.4
	OD - 3.75 OS - 4.00 (Gl)	Age = 21 yrs.	24.8 / 32.4
C.T.	6△ Exophoria @ 40 cm	62/59	X / 27
	OD - 1.75 - 1.50 X 176 OS - 1.25 - 1.00 X 161 (Glasses)	Age = 23 yrs.	X / 29.4
S.T.	Orthophoria	61/58	X / 27
	Emmetrope	Age = 20 yrs.	X / 32.2
C.K.	2△ Exophoria OD - 6.00 - 0.75	59/57	X / 39.2
	X 010 OS - 5.50 - 1.25 X 165 (Glasses)	Age = 21 yrs.	X / 49.0
M.C.	5.5△ Exophoria @ 40 cm	61/58	X / 10.8
	Emmetrope	Age = 22 yrs.	X / 10.7
K.M.	5△ Exophoria OD - 6 - 0.75	59/57	X / 7
	X 080 OS - 5.50 - 1.0 X 050 (Glasses)	Age = 21 yrs.	X / 5.6
B.G.	Orthophoria	64/59	X / 20.2
	Emmetrope	Age = 25 yrs.	10.2 / 22
D.D.	2△ Exophoria	69/66	32.33 / 78.33
	Emmetrope	Age = 27 yrs.	32.33 / 72.83
J.M.	Emmetrope	67/64	28.6 / 89.6
		Age = 32 yrs.	21/4 / 73.6

Results

Table 1 shows the results for the 10 subjects that participated in the study. Column 4 of the table shows the base-out to blur and break findings. Each datum is an average of three or more findings. The upper findings represent data taken conventionally, and the lower ones were taken when the lenses were decentered and set perpendicular to the lines of sight. The "X" stands for "no blur reported." This might result from the subject changing his or her criterion for blur. In most of the reported cases of base-out-to-blur findings, the data with the lenses decentered were larger than those taken conventionally, except subject J.M. Most of the subjects demonstrated this for the limits of single binocular vision, except subjects K.M., D.D., J.M., and M.C. Subject M.C. showed no difference in the findings, whereas subjects K.M., D.D., and J.M. demonstrated a decrease. Most of the subjects had a low phoria and enough fusional reserves to satisfy Sheard criterion. Subjects M.C. and K.M., who either marginally satisfy or fail to satisfy Sheard criteria, had no binocular complaints or symptoms.

Discussion

When a subject looks into the tubes of the haploscope for the purpose of measuring fusional limits, it is assumed that the eyes look through the optical center of the lenses all the time. As seen from Table 1, there are times when the eyes lag behind the rotation of the arms of the haploscope (refer to Figure 1). Column 4 of Table 1 clearly shows that, in most cases, the findings of the blur and break limits were larger when the lenses were decentered than when taken conventionally. The negative fusional vergence limits are usually low and the effect of induced prisms might not be significant enough. It was decided to concentrate on the positive rather than the negative limits. When the eyes look obliquely through the negative lenses, base-out prismatic effects are induced and a lower than ideal scale reading is recorded. Apart from this effect, oblique aberration brings on an earlier perception of blur. This may also influence the break finding. As shown in Figure 1, if the lines of sight lag behind by 4 mm, in an emmetropic subject, the induced prismatic effect is given by Prentice's rule $D = CF$; $D = 0.4 \times 2.50 = 1.00\Delta$, at least one prism diopter base-out induced in each eye. The effect becomes more dramatic if the subject is a medium or high myope like subject C.K. The subject's prescription is OD: - 6.00 - 0.75 x 010 and OS: - 5.50 - 1.25 x 165. If it is assumed that each eye has a spherical equivalent of - 6.25 Diopters, so that when this is combined with - 2.50, a - 8.75 Diopters lens would be placed in the lens holder. The induced prism is $0.4 \times 8.75 = 3.500$ prism diopters: a total of 7Δ in front of both eyes. The possibility of a greater or lesser lag than 4 mm cannot be neglected. On the other hand, when the eyes move faster than the haploscope arm, a base-in-prismatic effect is induced. This has an influence of making the findings higher than the ideal. Subjects K.M., D.D. and J.M. are three representatives of this effect. There is a third group whose lines of sight move at the same rate as the arms of the haploscope. This group demonstrates no significant change in the positive fusional limits. For example, subject M.C. showed no change in the fusional limits between the conventional and decentration techniques. Subject D.D. demonstrated an increase in the blur findings and a decrease in the break findings when the lenses were decentered. This demonstrates clearly how interchangeably the factors could operate in a single individual.

In the case of a hyperope, a base-in prismatic effect is induced when the eyes lag behind the movement of the arms of the haploscope. As a result, a higher than ideal base-out finding is recorded. The opposite effect happens when the eyes move faster than the arms of the haploscope.

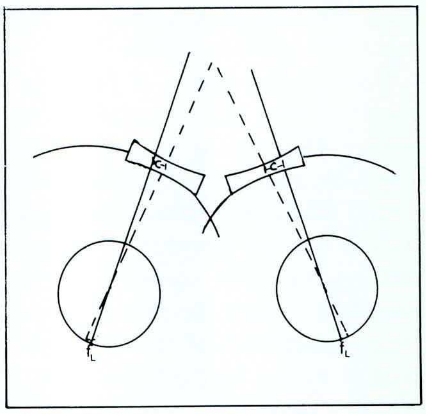

Fig. 1 Diagramatic representation of the lines of sight as they lag behind the movement of the arms of the haploscope during force convergence. C is the displacement of the lines of sight from the optical center of the lens. The induced prismatic effect is given by $\Delta = CF$.

Conclusion

The haploscope, like the Risley prism, is usually employed in measuring and training vergence limits. The above study has clearly indicated the need for using the haploscope mainly as a training instrument rather than as an instrument for accurate measurement of fusional limits. When it is employed in measuring these limits, it should be used with caution. Of the 10 subjects studied, only 10% demonstrated the classical theoretical expectations. 20% showed the base-in induced effect and 60% the base-out induced prism effect. 10% demonstrated a combination of both the base-out and base-in effects. There is, therefore, a need to have a rule for decentration of the lenses. This is more important if the subject is a high myope. For example, in a medium myope like the case above, there was a difference of 10 prism diopters increased when the lenses were decentered 8 mm in front of both eyes. A total of 7 prism diopters were induced when the lenses were not decentered. By simple arithmetic, about 1.0Δ induced prism diopter was eliminated by decentering 1 mm. This corresponds to a 10Δ prism diopter scale reading. This implies that the lenses should be decentered 1 mm for every 10 prism diopters of the haploscopic arms scale reading.

It is therefore suggested that the lenses be decentered 1 mm inwards for every 10 prism diopters of convergence.

Reference

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CLINICAL RESEARCH

Adapting New Testing Methods to the Tangent Screen

R. Pace*

Abstract

Tangent screen examination has remained a popular method for detecting visual field defects in spite of the recent availability of more sophisticated perimetric instrumentation. Many techniques used with these newer instruments can be adapted for use with the tangent screen in order to enhance its sensitivity in detecting early field problems. Some of these techniques, including the glaucoma screening method of Armaly and Drance, are discussed with this emphasis.

Abrégé

Le campimètre demeure un instrument de choix pour le dépistage des défauts du champ visuel et cela malgré l'avènement des périmètres électroniques. Plusieurs techniques utilisées avec ses nouveaux instruments peuvent s'adapter au campimètre pour accroître la sensibilité de ce dernier dans le dépistage précoce des défauts du champ visuel. En marge de ces adaptations, l'autre décrit certaines techniques, entre autres, la technique d'Armaly et Drance pour déceler le glaucome.

Although projection perimeters such as the Goldmann or Tübinger are considered to be the standard field testing instruments and, more recently, automated or semi-automated instruments such as the Fieldmaster or Friedmann Visual Field Analyser have gained recognition, it remains that the tangent screen is the most commonly used field testing device in the private practice setting.[1] Since 90% of field defects are potentially detectable using the tangent screen,[2a] it seems to be a logical choice for a field testing instrument. Its attraction becomes even greater when its simplicity and low cost are considered. Unfortunately, these advantages tend to be offset by the degree of skill required by the examiner as the detection of most, if not all, field defects is highly dependent upon technique.

Traditional methods of field examination with the tangent screen involve plotting the blindspot, followed by mapping the limits of the central field in the vertical, horizontal and oblique meridians.[2b] Scotomata within this isopter can be sought by having the patient report the disappearance of the test object as it is moved through the central field in a zig-zag[3] or rosette[4] pattern. The experienced perimetrist will acknowledge the difficulty in detecting an early, subtle field defect using these methods, and should seek to improve the sensitivity of the tangent screen by means of alternate techniques.

When developing a field testing procedure one must be familiar with the anatomy of the visual pathways and the corresponding parameters of anticipated field defects. Since a detailed discussion of these topics is beyond the scope of this paper, the reader is referred to any standard text on visual fields should this information be required. It suffices to state that the field of vision is functionally centred about the fixation point and is split vertically due to decussation of the nasal nerve fibres in the chiasm, and horizontally by the distribution of the retinal nerve fibres and the retinal vasculature.[2c,5a] For this reason, chiasmal and post-chiasmal lesions usually result in bilateral field defects with vertical steps or hemianopsias, and lesions of the retinal nerve fibre layer or retinal vasculature will result in unilateral defects with horizontal steps. When examining the horizontal or vertical meridian it is therefore necessary to test on each side of the meridian rather than directly along it in order to detect a step-like defect. If the target were moved directly along the meridian, responses could be haphazard depending upon the exact nature of the defect and accuracy of fixation, possibly labelling the patient as a poor observer, and probably missing the abnormal field.

For the central 30 degrees of the field, a static testing technique is superior to a kinetic procedure;[6a] a stationary target is exposed in the desired location and the patient reports whether it has been seen or not. By varying the target size or relative contrast, it is possible to determine a threshold sensitivity for any test location. When a target is used such that it should be above threshold for the chosen test location, the procedure is termed a supra threshold spot check. This method of supra threshold static spot checking can be used to search within a given isopter for an area where the target should be seen, but is not, representing a scotoma. The equivalent kinetic technique, which is considerably more difficult, requires the patient to report the disappearance of the moving target. Fixation control using the static technique is not compromised since the patient is able to see the target for only a brief period and is less likely to alter fixation toward a briefly exposed immobilized target. The accepted

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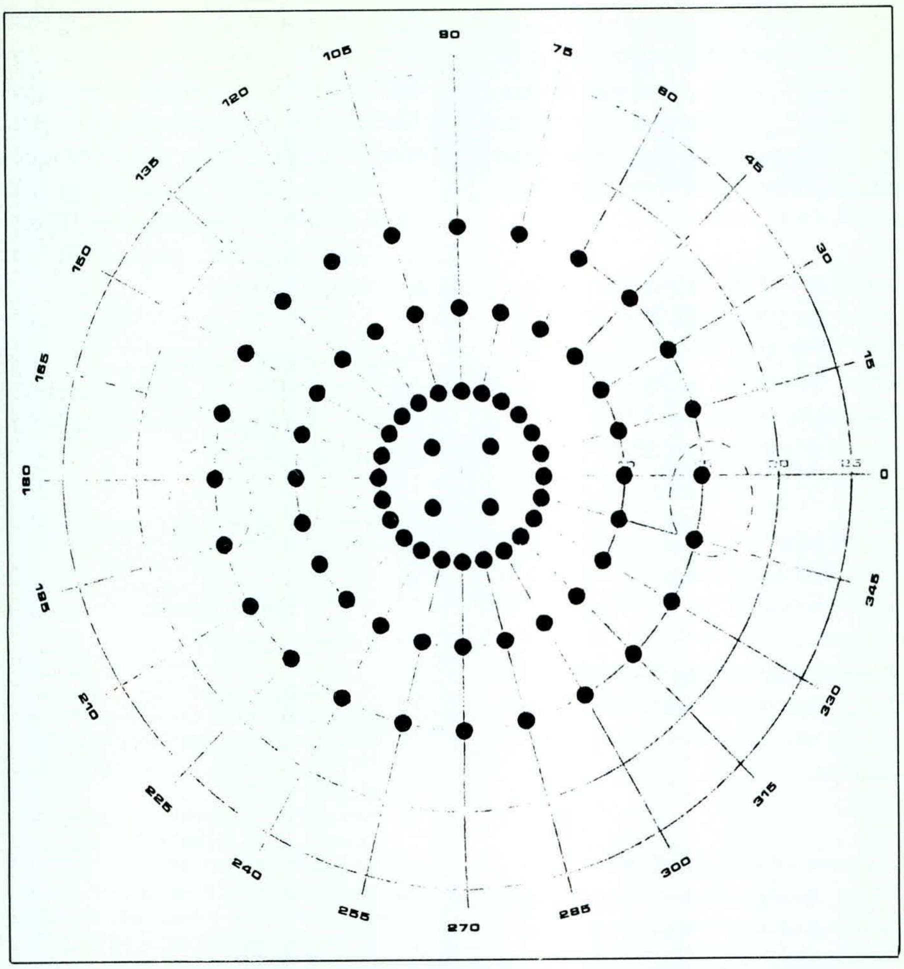


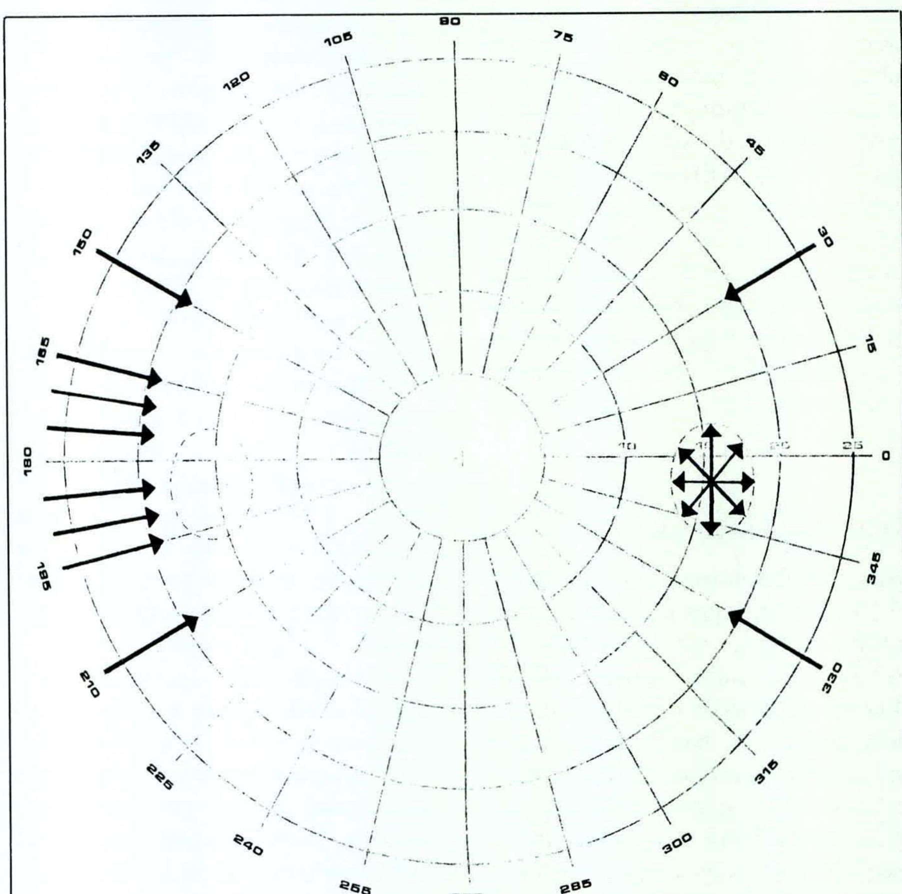
Fig. 1 — Location of 76 supra threshold static spot checks

protocol of testing from non-seeing to seeing is also maintained.

The most frequently-performed field investigation is that used for the detection of suspected glaucoma,[6b] the earliest defect of which is usually a small, relative scotoma isolated from the blindspot, in the Bjerrum arcuate area of the field, or a depression nasally in the field.[7a] Since kinetic perimetry has been shown to be ineffective in detecting these early scotomata,[8] Armaly[9,10] proposed a screening method subsequently modified by Drance et al,[11a] utilizing supra threshold static spot checking within areas of the visual field commonly affected by glaucoma. A total of 76 supra threshold spot checks are made in the central area, and in addition, the nasal field is investigated for a step defect using two target intensities, one central and one peripheral.

Although originally designed for use with the Goldmann perimeter, the Armaly-Drance screening method can be adapted to the tangent screen in the following manner. The first step is to determine a test stimulus which provides a comparable value to that normally used on the Goldmann perimeter. On a tangent screen this will usually be a 1 mm white target at a 1 m test distance (1/1000/w).[7b] An alternate method would be to select the target which is just detectable at a 25 degree eccentricity from fixation as recommended by Drance,[11b] thus ensuring that all central spot checking is conducted with a supra threshold target without sacrificing sensitivity by using a target size which is too large. Older patients or those with reduced vision may require the use of a larger target. Static spot checks are made at each of the following locations in an orderly sequence: every 15 degree meridian 5, 10 and 15 degrees from fixation, and at 4 locations inside the 5 degree circle, as shown in figure 1. Static spot checking on the tangent screen can be accomplished by concealing the test

Fig. 2 — Kinetic test locations ▼



object while positioning the wand, then by rolling the wand to briefly expose the target spot, or by using a Lumiwand which incorporates a small electric lamp and switch.

If a spot check is not detected, a second presentation is made at the end of the sequence and if it is missed a second time, a scotoma is likely present. The perimetrist can then attempt to plot it using standard kinetic techniques. If the second presentation is detected, the response can be accepted as normal. Following the spot checks, the blindspot is plotted using the same target and the nasal field is investigated kinetically at 5, 10, 15 and 30 degrees above and below the horizontal to detect a nasal step. Finally, two points temporally, 30 degrees above and below fixation, can be plotted to yield a partial isopter (figure 2) or, if desired, the entire isopter can be determined. It is not possible to investigate the peripheral nasal field using the tangent screen, as would be done with the perimeter.

The Armaly-Drance method has been shown to have a sensitivity of 96% for detecting glaucomatous field defects[11c] which means that the chance of missing an abnormality is minimal. Although these studies were conducted using a Goldmann perimeter, it is likely that a similar technique using a tangent screen would be similarly more effective when compared to conventional procedures. Also, since the central field is so thoroughly investigated, it is unlikely that field defects from causes other than glaucoma would be missed.

Other Considerations

Stimulus duration (for static testing)

Spot check exposures should be no longer than 1 sec to reduce the tendency to alter fixation, or influence the level of retinal adaptation achieved by the background illumination;[6c] however, adequate duration is necessary to allow retinal summation effects. Since this is less than 0.1 sec,[6d] it is unlikely that an exposure time which is too short could be obtained using a tangent screen. An interval between exposures should be allowed to permit adequate perception of each presentation. This can be varied depending on individual patient ability, however it should not be less than 2 sec.[6e]

Target speed (for kinetic testing)

The International Perimetric Society does not list an ideal rate of target movement in its standards.[12a] Practically, a rate of 3 to 5 degrees per sec is recommended.[7d]

Target blur

Blur of a test target decreases its stimulus value in the central 30 degrees of the field.[6f,7c] Since the entire tangent screen falls within this limit, appropriate refractive correction is required for the 1 m test distance.

Background illumination

The recommended illumination for tangent screen examination is 7 foot-candles (fc).[2c,5b,13] Portney and Rubenzer[14] have shown that the tangent screen compared favorably to the Goldmann perimeter in detecting glaucomatous defects when the illumination was at this level, but sensitivity was reduced dramatically when the illumination was increased to 12 fc superiorly and 8 fc inferiorly by using the ceiling lamps in the examination room. It is important, therefore, to perform the test with the background illumination reduced to 7 fc. This can be obtained practically using a 40 watt frosted light bulb in a standard Luxo lamp, directing the lamp centrally from a distance of about 1.5 m to provide even illumination on the screen. It is preferable, however, to confirm that proper illumination is obtained by means of a light meter.

Although many perimeters are available which may be superior to the tangent screen, it is difficult for most practitioners to justify the large investment needed to obtain and operate such instrumentation. It therefore is important for the practitioner to use tangent screen procedures which maximize the capabilities of the instrument in order to detect field defects at an early stage. The use of supra threshold static spot checking, specifically the technique of Armaly and Drance, correct illumination and appropriate target size can aid the perimetrist in achieving this result.

Acknowledgements

I thank Drs. G. Strong and J. Brisson for their many helpful suggestions.

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Corneal Distortion Eliminated by Refitting with Gas Permeable Lenses

R.R. Molzan*

The patient, M.T., a forty-year old female, first came to my office on August 19, 1981. She had been wearing PMMA lenses all her waking hours. The original fitting was done by another optometrist who had discharged her six months earlier with no apparent problems. The present lenses were three years old.

One week earlier, the patient had been treated by the emergency M.D. at the hospital for an apparent foreign body irritation in the left eye. Her chief complaint at this time was that the vision was still blurry with her glasses and that the left eye was sore after a full day of lens wear.

Initial Findings

Contact Lens Acuity	
6m	**40cm**
O.D. 6/7.5	.37m
O.S. 6/7.5	.37m
Present Spectacle Acuity	
O.D. 6/12	.37m
O.S. 6/20	.50m
Present Spectacle Rx	
O.D. -4.25 -0.75 X 007	
O.S. -4.25	
CL Overrefraction	
O.D. +0.25	6/7.5
O.S. +0.25	6/7.5
Best Spectacle Refraction	
O.D. -4.50 - 1.50 X 170	6/7.5
O.S. -4.75 -2.00 X 180	6/20

Keratometer Readings
O.D. 43.50 -1.50 X 180
(slight distortion)
O.D. 42.50 -2.50 X 180
(severe distortion)
Ocular Motility — normal
Ocular Health Examination
— unremarkable
Biomicroscopy — present lenses 2mm lag O.U., good centration, no central corneal clouding, no staining with flourescein. Lenses worn 7 hours. Lenses badly scratched.

A diagnosis of corneal distortion secondary to the initial trauma was made. The patient was advised to discontinue her lens wear until the symptoms resolved. She refused this recommendation leaving us the alternative of refitting with lenses of gas permeable material, rather than PMMA.

Original Lens Specifications
(from previous practitioner)

	O.D.	O.S.
Base Curve	7.60	7.60
Diameter	9.5	9.5
Optic Zone	8.3	8.3
Peripheral Curves	7.8/9.5	7.8/9.5
Centre Thickness	0.12	0.12
Power	-4.50	-4.50

New lenses of Sil-35* material were ordered with the same specifications since the PMMA lenses were performing adequately in terms of physical fit and refractive error neutralization.

The new lenses were dispensed with instructions to reduce wearing time as much as possible. At one week, the patient was so comfortable that she had resumed wearing the lenses all waking hours.

Final Findings
(one month with new lenses)

Contact Lens Acuity	
6m	**40cm**
O.D. 6/6	.37m
O.S. 6/6	.37m
Spectacle Acuity	
O.D. 6/6	.37m
O.S. 6/6	.37m
Best Spectacle Refraction	
O.D. -4.50 -1.50 X 170	6/6
O.S. -4.75 -0.50 X 180	6/6

Keratometer
O.D. 43.75 -1.50 X 180 (no distortion)
O.S. 44.00 -1.00 X 180 (no distortion)

As can be seen from the final findings, the spectacle vision had improved for both eyes and the distortion had been resolved. The patient also reported no discomfort with any wearing time of the gas permeable lenses. There also was an improvement in the contact lens acuity which was a result of new unscratched lenses, not the new lens material itself. This case demonstrates the effectiveness of gas permeable lenses as an alternative to PMMA.

*Optometrist
Leamington, Ontario

*Sil-35 — A polysiloxanyl (alkyl) copolymer 35% with PMMA available from Trans Canada Contact Lens Ltd.

VISION CARE NEWS

Calendar

1983

June 25, 26:
OEP Foundation: Marketing Professional Optometry for the 80's
Washington, D.C.
Information: Frances Gaul, Events Co-ordinator
OEP Foundation
2912 S. Daimler
Santa Anna, California

June 26 - July 1:
A.O.A. 86th Annual Congress

Washington, D.C.
Information: Linda Milius, Congress Manager
(314) 991-4100 ext. 256

July 5 - 8:
C.A.O. 18th Biennial Congress

Vancouver, B.C.
Information: Michael J. DiCola, Administrative Program Co-ordinator (613) 238-2006

October 5, 6:
New York Association for the Blind: Innovations in Low Vision

Information: Anniversary Committee
New York Light House Low Vision Service
111 E. 59th Street
New York, N.Y., 10022, USA

1984

February 12 - 14:
B.C.O.A. Continuing Education Seminars

Information: Tom Little, Program Director
(604) 685-1810

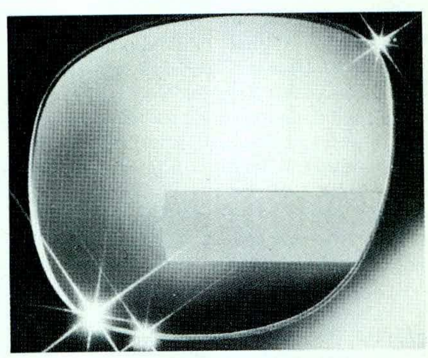
April 12 - 14:
I.O.O.L. General Meeting

London, England
Information: P.A. Smith, Secretary
10 Knaresborough Place
London SW5 0TG England

Conflex Contact Lenses

Zeiss has introduced a rigid, gas permeable lens, manufactured from Cellulose-Aceto-Butyrate (CAB) with Ethylene-Vinyl-Acetate (EVA). The lens is moulded between precision glass dies, which ensures exact reproducibility. The edge design reduces the foreign body sensation, thus increasing comfort. Conflex lenses can be used to neutralize high degrees of corneal astigmatism. The lenses are available from stock in 33 base curves, two diameters and a power range from +20.00D to -20.00D.

For more complete data, contact:
Carl Zeiss Canada
45 Valleybrook Drive
Don Mills, Ontario
M3B 2S6



Vision-Ease Prism Segment Multifocals

For those who have been searching for a convenient solution to the problem of patients with convergence/accommodation difficulties at near, Vision-Ease has developed a prism segment multifocal. The segment is a 10mm deep ribbon which, when properly placed, will allow distance vision below the add. The prism/addition combinations are made of high index (1.701) glass for thinner segments. There are some limitations on the size of frames that can be used and, although some stock is available, delivery time can be up to four weeks. For more information on this interesting lens, write:

Vision-Ease Canada Ltd.
1625 Sismer Road, Unit 16
Mississauga, Ontario
L4W 1V6

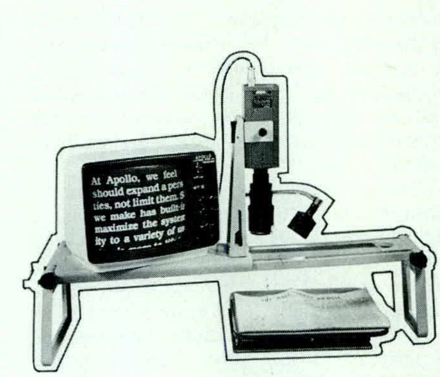
Apollo Electronic Visual Aids

Apollo is presenting two new visual aids, the Dual Image II and the Porta Reader II.

The Dual Image II has the capability of combining the images from two separate cameras. Its features, a 19-inch monitor, compact configuration, built-in typing capability and easy-to-use controls, make this visual aid practical for vocational applications. It can be adapted for a variety of uses, including: transcribing from rough drafts, displaying instrument and CRT readouts, reading a schematic & soldering a circuit board, teaching reading and writing to partially-sighted students.

The Porta-Reader II has complete portability and versatility. It can be viewed in any position and the base can be compacted for viewing conventional materials, or widened for newspapers and maps. For a catalogue, and further information, write:

Apollo Lasers Inc.
6357 Arizona Circle
Los Angeles, California
90045, USA



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BOOK REVIEWS

Pediatric Optometry, Jerome Rosner; Butterworth Inc., U.S.A., 1982, 458 pp, hard cover, w/illus., $39.95 (U.S.).

Finally, a textbook written by an optometrist specifically for optometrists! This reference book covers all aspects of diagnostic services and almost all treatment services for the management of the pediatric patient.

The textbook is divided into two sections. The first part covers the examination procedures and diagnoses. Each chapter starts with a question, eg., Why is the patient seeking services? (ch. 1) How clearly does the patient see? (ch. 3) What is the patient's binocular status? (ch. 6).

The second part reviews the treatment procedures available for such diagnoses such as ametropia, strabismus, nystagmus, binocular vision and perceptual skills dysfunctions.

The author describes various regimens of treatment procedures and employs a problem-solving orientation throughout the book. The application of "flow charts" aids immensely in working through the "chief complaint" to final resolution and recommendations.

Dr. Rosner's experience in both private and institutional practice has provided him with the expertise to write such a comprehensive text. It offers a single source of clinical information for the practitioner. For the optometric student, general optometrist or pediatric optometrist, this text provides a wealth of information and would prove a valuable addition to one's professional library.

Joseph Mittelman, O.D., FAAO.

Dictionnaire de la Science de la Vision — Michel Millodot, Ph.D. publié par L'Institut et Centre d'Optométrie, Paris, 1982, 307 pages.

Tout dictionnaire est un outil de travail pour le lecteur, l'écrivain et le chercheur. Il y en a pour tous les goûts, pour toutes les disciplines et branches de la science. Quand un nouveau dictionnaire vient combler une lacune dans la litérature d'une discipline il y a raison de se réjouir. Ainsi donc la publication du *Dictionnaire de la Science de la Vision* du Dr. Millodot vient combler un vide dans la litérature optométrique professionnelle du coté francophone.

Le volume comprend 2060 termes répartis inégalement sur les sujets d'optométrie, d'anatomie, physiologie, pathologie et et maladies, optique et lentilles ophtalmiques, instruments, tests et un nombre de noms d'individus ayant contribué à la science de la vision.

Chaque terme est numéroté selon sa position alphabétique qu'il occupe sous la lettre appropriée de l'alphabète. Ainsi, sous la lettre "O" il y a 281 termes, sous "J" on ne trouve que 8. Chaque terme est suivi de la traduction anglaise mais la définition ou la description n'est qu'en français. Au besoin il y a référence à un autre terme pour une explication plus complète, e.g. — Fixation (disparité de) voir disparité.

Le volume se termine par un index de termes anglais correspondants aux termes français. Le terme anglais est suivi du numéro du terme français permettant ainsi de retrouver la traduction rapidement. e.g. Wilson's disease M37 — le terme français sera retrouvé sous la lettre "M", le 37ième entré.

Même si ce volume ne contient pas le nombre de termes contenus dans le *Dictionary of Visual Science,* il est plus qu'adéquat pour les besoins quotidiens du practicien, de l'étudiant ou de l'auteur néophyte. C'est un travail qui devrait prendre place à coté du Larousse et du Harrap.

La profession est en dette envers l'auteur pour une contribution et un outil de travail si précieux.

G. Maurice Belanger

Clinical Medicine for the Occupational Physician by Michael V. Alderman and Marshall J. Hanley, Published by Marcel Dekker, Inc., New York and Basel. 1982.

The subject matter of clinical medicine for the occupational physician, as seen by Michael V. Alderman and Marshall J. Hanley, divides into seven sections. Section I, *Basic Orientation for Practice*, surveys the history of occupational medicine in the USA, and the manner in which the work of occupational physicians is prescribed by federal regulations. Ethics, and epidemiology and biostatistics complete the orientation. II, *The Worker/Patient*, deals with working women, elderly workers, and disabled workers. III, *The Occupational Health Program*, tackles planning and evaluation of an occupational health program, health promotion and screening, functional assessment for heavy physical labour, and the health of travellers. IV, *Alcoholism and Mental Illness*, opens up alcohol abuse and stress and mental illness. V confines itself to one chapter on approaches to occupational cancer; VI also has but a single topic: occupational dermatoses.

VII, *Major Clinical Problems*, focussed for physicians in industry, comprises musculoskeletal disorders, gastrointestinal and hepatic concerns, occupational pulmonary disorders, hypertension, cardiovascular and neurologic diseases of the ear, nose and throat.

In evaluating this book, I was influenced by my sense that occupational medicine is in an uncomfortable state, torn between contrasting orientations. This book pertains to one of the orientations, that of the practice of clinical medicine within the framework of employment. Leon J. Warshaw, in the foreword, points out that occupational medicine now operates in the hitherto taboo sphere of non-occupational health problems detected in connection with employment. Robert Murray, a noted British practitioner of occupational medicine, speaks of the *effects of health on work*; health in work, a variation on the Murray theme, is largely what this book is about.

By contrast, *the effects of work on health* has been the driving force of occupational medicine for the past century plus, paralleling the drive towards public health and hygiene over the same period.

There can be no doubt that managers and workers alike expect workplace physicians to practice clinical medicine. But the historical criticism has always been that workplace physicians who concern themselves overmuch with non-occupational disease might run the risk of missing occupational disease. Worse still, physicians concerned with individuals rather than groups might be criticised politically for being tools of management concerned to seek out the causes of disease among the vulnerabilities of individuals rather than the toxins of the work place. This book could certainly be criticised on those grounds, but it is a book whose purpose have to be considered all the same.

From a clinical point of view, the book has patchy coverage, as it acknowledges. (For example, there is almost nothing on eyes!) The orientation is exclusively towards the practice of clinical medicine in the USA. Its patchiness reflects the incoherence probably inevitable with a multi-author text addressed to a subject which in any case lacks much in the way of intellectual structure — how can a subject have structure when it is struggling with dichotomy disease?

For all its shortcomings, I think this book important, and even a bit courageous. It ought to be useful to occupational physicians who are out of range of refresher courses and the like. It could also be useful to any physician who feels vaguely guilty about practicing the kind of occupational medicine which concerns itself with health in work. For that reason, the book should be explored by seasoned practitioners of occupational medicine because they, too, may be experiencing the debilitating influence of dichotomy disease, and they may be influential enough to bring about the refocussing treatment which the subject so badly needs. The middle of the spectrum is always the position most tempting for those seeking compromise; for occupational medicine this may very well be the right place to look, and *Clinical Medicine for the Occupational Physician* may be pointing us that way.

Gordon Atherley, President & C.E.O.
Canadian Centre for Occupational Health and Safety

Optics in Vision: Foundations of visual optics and associated computations (second edition), by Henri Obstfeld, Butterworth & Co. (Publishers) Ltd., London, 1982. 411 pp. illus.

There seems to be an unwritten rule that no lecturer ever finds a textbook which completely meets the requirements for his course. This appears to have been Henri Obstfeld's rationale for writing *Optics in Vision.* Topics considered include schematic and reduced eye models for emmetropia and ametropia, image formation in uncorrected and corrected ametropia, calculation of retinal image size, accommodation, presbyopia, aphakia, astigmatism, applications of Newton's equation, effects of spectacle correction on convergence demand, optics of the Purkinje images, vision with contact lenses and vision underwater. The book ends with a brief (2½ pages) chapter which describes conditions which give rise to accommodation, rendering an emmetropic eye apparently myopic (e.g. instrument myopia).

The text is well-supplemented by the many line drawings and worked examples. Many chapters include exercises for the reader and sample questions from previous examinations set by various British organizations such as the Association of Dispensing Opticians, British Optical Association, etc.. The many brief chapters devoted to calculation of retinal image size for specific refractive states, both uncorrected, and corrected with spectacle lenses, provide the student and busy practitioner with a cookbook-style guide to solving these problems. The chapters on vision with contact lenses and underwater make excellent reading on subjects which should be of more than passing interest to vision care providers. The role of blur circles in the perception of image size is clearly described.

If this book has any faults, they are due to the author's attempt to discuss such a wide variety of topics within the confines of a text short enough to be used in a one or two-term course on physiological optics. Obstfeld has taken a "bones without the meat" approach, introducing concepts with a minimum of explanation or derivation. The physiological and psychological aspects of vision are given relatively little attention — a serious shortcoming in a book which is intended "to relate the principles of geometrical optics to visual optics", as stated in the preface. Nevertheless, there are attempts to relate the calculations to clinical situations such as the effect of spectacle correction on the need for an addition at near, and the use of rigid vs. hydrogel contact lenses and their effects on vision and the eye as the lens fit changes with time.

On the whole, *Optics in Vision* is a cursory overview of applications of geometrical optics to certain aspects of physiological optics. As such, it is of limited value to the educator as a text book, but may provide a good review of applied optics for the student and practitioner.

B. Ralph Chou, M.Sc., O.D., F.A.A.O.
School of Optometry,
University of Waterloo

The History of the British Optical Association 1895-1978 by Margaret Mitchell, M.A., published by the British Optical Association and the British Optical Association Foundation, Nelson Brothers of Chorley, 1982. 308 pages, illustrated.

Pride in one's family, city, country or profession is a healthy and very human trait. Providing it is not tinted with arrogance and self-conceit, it can be an important factor in motivating one to greater accomplishments.

Pride is rooted in history, for one cannot take pride in family, city, country or profession unless one is fully aware of the accomplishments of those who preceded us.

Such must have been the thoughts of Margaret Mitchell as she collected, collated and planned her unique book on the history of the British Optical Association.

In a mere 300 pages, she has succeeded in expounding the formation, progress, struggles and achievements of those men who founded the British Optical Association and guided it through its many crises and battles to reach the high level of academic professional and social status the profession enjoys today. One cannot but be inspired by the reading of its history. One cannot be otherwise than proud to belong to this august body, the ultimate outcome of the efforts of so many dedicated, and farsighted individuals, from its founders to the present day leaders and educators.

The book has 24 chapters of varying length. Following a general comment on the evolution of ophthalmic optics and spectacles and the specific conditions leading to the formation of the association, the book covers the following:

1. legislative efforts culminating in legal status, registration and entry into the National Health Service.
2. education and its importance as the cornerstone for professional growth and development, qualifying examinations, the founding and development of its institutions, including the London Refraction Hospital and its several schools, all but one of which are now integrated into the university system.
3. relations with medicine and ophthalmology.
4. the various optical associations in existence in Britain and their cooperation eventually leading to the amalgamation of all into the British College of Ophthalmic Opticians (optometrists). This brought about the demise of the BOA as an examining and licensing body.
5. the physical assets: the national office and its changes of address, its world-renowned library and museum.
6. the various journals and publications which it has sponsored.
7. the work, efforts and achievements of the five permanent secretaries and a number of its more outstanding members who contributed to the educational level and to the political and social organization of the profession. Not to be overlooked, the untiring members of the staff over its many years.
8. the role of members in the development of the International Optical and Optometric League.
9. finally, the decision to create a College of Optometrists and the demise of the BOA as a licensing and examining body.

The book is well printed on matt paper and reads well. It is enhanced by numerous illustrations of historical interest, such as photographs of important individuals or groups, extracts of correspondence, old documents and advertisements, pictures of the library and the various buildings which housed the BOA over the years, of old spectacles, equipment and other optical lore.

There is no subject index as such, but the chapter contents, listed in the table of contents, are detailed enough to permit the locating of some subject matter (but not the details pertaining to specific topics). One would need to read several pages to locate them. This does not, however, diminish the historical and documentary value of the book.

To anyone interested in the development of worldwide Optometry, this book will serve as a guide because the difficulties encountered in Britain are worldwide and differ only in emphasis or degree. Education, legislation and unselfish dedication to the cause are the building blocks to success. The example of the British Optical Association should give heart to those who are just emerging as a profession in so many countries of the world.

G. Maurice Belanger, Editor

Drug-Induced Ocular Side Effects and Drug Interactions. 2nd Edition. By F.T. Fraunfelder and S. Martha Meyer. Published by Lea & Febiger, Philadelphia, 1982, $36.00 in Canada, 500 pp. plus index.

All active drugs produce more than one effect. Drugs may produce unexpected results because of the number of drugs employed, the variety of conditions in which they are used, their interactions with each other, and patient variables. Unless someone maintains a Registry of Drug-Induced Ocular Side Effects, the task of keeping track of the potential complications would be impossible. Dr. Fraunfelder and his collaborators maintain the Registry and complete the next step which is summarizing the data in a usable form in this book.

There are two conflicting ways to look at ocular side effects. One is to say that most drug adverse effects are not reported so one sees only the tip of the iceberg. The other is to point out that many of the reported effects are the result of coincidence and represent neither a predictable hazard nor a pharmacological action of the drug in question. A person could have a myocardial infarction after brushing his teeth and few would claim this to be an adverse effect of the toothpaste.

One point which bothers me is that, for a given drug, every reported "effect" is listed; for example, we find both miosis and mydriasis listed for pilocarpine. One could argue that miosis is the expected result of a direct-acting muscarinic agent and mydriasis as a response must be so exceedingly rare as to invite confusion and to dilute the utility of the listing.

Once again the evidence indicates the relative safety of cyclopentolate and tropicamide. There seem to be no significant adverse systemic reactions from topical application of the usual doses of tropicamide. The authors conclude: "Major ocular effects due to these drugs are quite rare".

A comparison of the second edition with the first shows that the second is 174 pages longer. In the listing of 140 kinds of possible ocular effects the second edition adds about 30 new classifications while dropping about 5 from the older list.

In each chapter of the new edition some new references are provided and older ones updated.

The ready reference features of this book are its strong points. It provides both the generic and the proprietary names that are used in most countries around the world. The tabulation of potential drug interactions is another valuable contribution of the authors. Side effects associated with both systemic and topical administration of each drug are listed and the authors summarize the risks in a statement of clinical significance.

The publisher too deserves credit for the easier-to-read typeface in the new edition.

Drug-Induced Ocular Side Effects and Drug Interactions is a very practical handbook for the optometrist. Relatively little attention is given to contact lens care products or even to the preservatives in ophthalmic solutions.

William M. Lyle
School of Optometry
University of Waterloo

Visual Fields — A Basis for Efficient Investigation by C.H. Bedwell, Published by Butterworth's Scientific, London, 1982, 219 pages.

The recent introduction of automated, or semi-automated instruments for testing the visual field has made it possible for the practitioner to reduce the time spent and increase the accuracy of results when compared to traditional, more laborious methods of perimetry. The author, whose background is in visual science, engineering and visual ergonomics, has prepared a text which includes in its twenty-five chapters, an overview of these developments.

The first several chapters address the importance of testing the visual field and provide an historical review of the development of traditional instrumentation such as the arc perimeter, Bjerrum screen, and Goldmann perimeter. The concepts of kinetic and static (both single and multiple presentation) perimetry are adequately covered, including the relative advantages and disadvantages of each method.

The next chapters are devoted to descriptions of field screening and testing devices ranging from the Harrington-Flocks screener, introduced in 1954, to the latest computer-controlled instruments such as the Octopus and Perimetron. Descriptions of each instrument are concise, giving necessary historical background, design rationale, method of operation, instrument features, limitations, and, in some cases, suggestions for improving the instrument's capabilities. A large section is devoted to the Friedmann Visual Field Analyser (FVFA) Mark I and Mark II, which the author co-developed.

Following the descriptions of individual instruments there is a group of fairly detailed chapters reviewing the photometric and physiological aspects of field investigation. The next chapters illustrate how these principles were applied in the development of the FVFA. He describes performance characteristics of the FVFA including summaries of several clinical studies. There is also a brief chapter on the clinical evaluation of automated perimeters such as the Fieldmaster and AutoField. The final chapter concludes that single and multiple pattern static perimeters are both effective and efficient for investigating the visual field. In many cases, the instruments have proven to be superior to the laborious traditional methods with tangent screen or manual perimeter.

Although this book is informative, adequately referenced and generally quite readable, I have some reservations in recommending it unconditionally. It cannot be considered as an introductory or basic reference textbook on visual fields: there are no sections on visual pathway anatomy or field interpretation. There is little information that could be adapted to the basic office tangent screen. Also, there is a disproportionate emphasis placed on the Friedmann Visual Field Analyser, which the author uses to illustrate most features of exemplary instrument design. I am, however, willing to forgive this indulgence as his material is well-documented and he does discuss some of the instrument's shortcomings.

For the practitioner considering the purchase of one of the newer field testing instruments, this book will provide much of the material necessary to make a decision based on sound design principles and clinical performance, rather than on promotional information. This volume will also prove useful for those interested in an up-to-date overview of field testing theory and recent developments in instrumentation.

Rodger Pace, O.D.
School of Optometry
University of Waterloo

Vision Care News from P. 99

Ciba Bi-Soft Contact Lenses

Ciba has recently introduced a newly-designed bifocal soft contact lens. It has two concentric visual zones and, at present, it is available from plano to +6.00D distance powers and add of +1.50D, +2.00D, +2.50D. For further details, write:

Ciba Vision Care Inc.
2121 Argentia Road
Mississauga, Ontario
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Nicolet Instrument Canada Inc.
1 - 1200 Aerowood Drive
Mississauga, Ontario
L4W 2S7

New "Old" Product from Zeiss

Readers recalling our last issue's cover will be interested to learn that Carl Zeiss Ltd. has produced a very limited number of replicas of its brass microscope for collectors (as pictured on the C.J.O. cover, March, 1983). Complete details can be obtained from:

G.A. Wheeler
Sales & Marketing Manager
Carl Zeiss Canada Ltd.
45 Valleybrook Drive
Don Mills, Ontario
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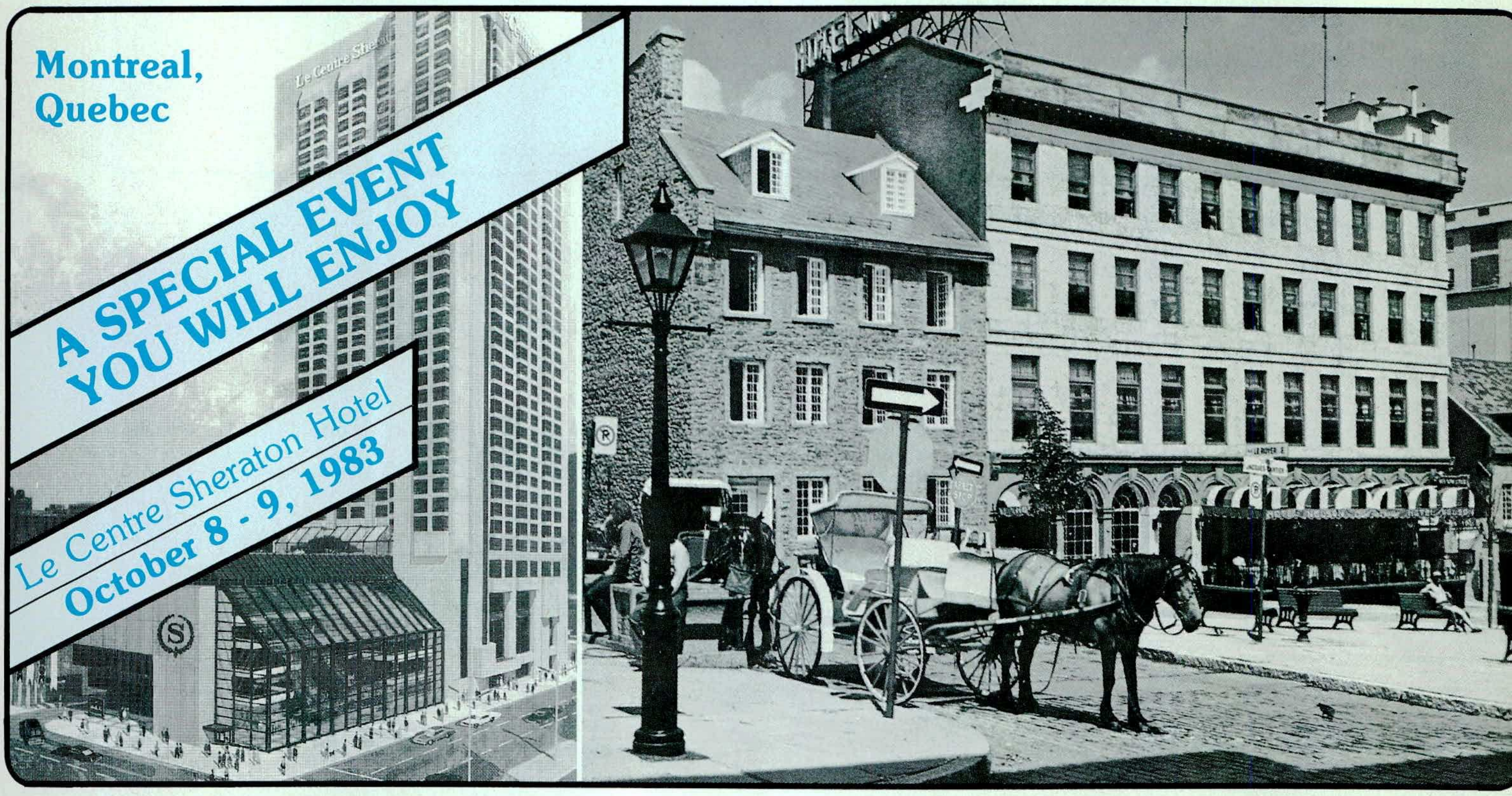

TOPICS:
- 10 years experience on extended wear
- Vascularisation
- Infiltrations
- Adjustement for aphakic
- Lacrymal physiology
- G.P.C.
- Corneal Oedema and allergy reaction
- Orthokeratology
- New development in gas permeable lens
- Bifocal soft contact lenses
- Intraocular lens
- etc...

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- **Dr. Charles W. McMonnies, O.D.** (Australia)
- **Dr. John De Carle, O.D.** (England)
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- **Dr. Michel Laflamme, M.D.** (Québec)
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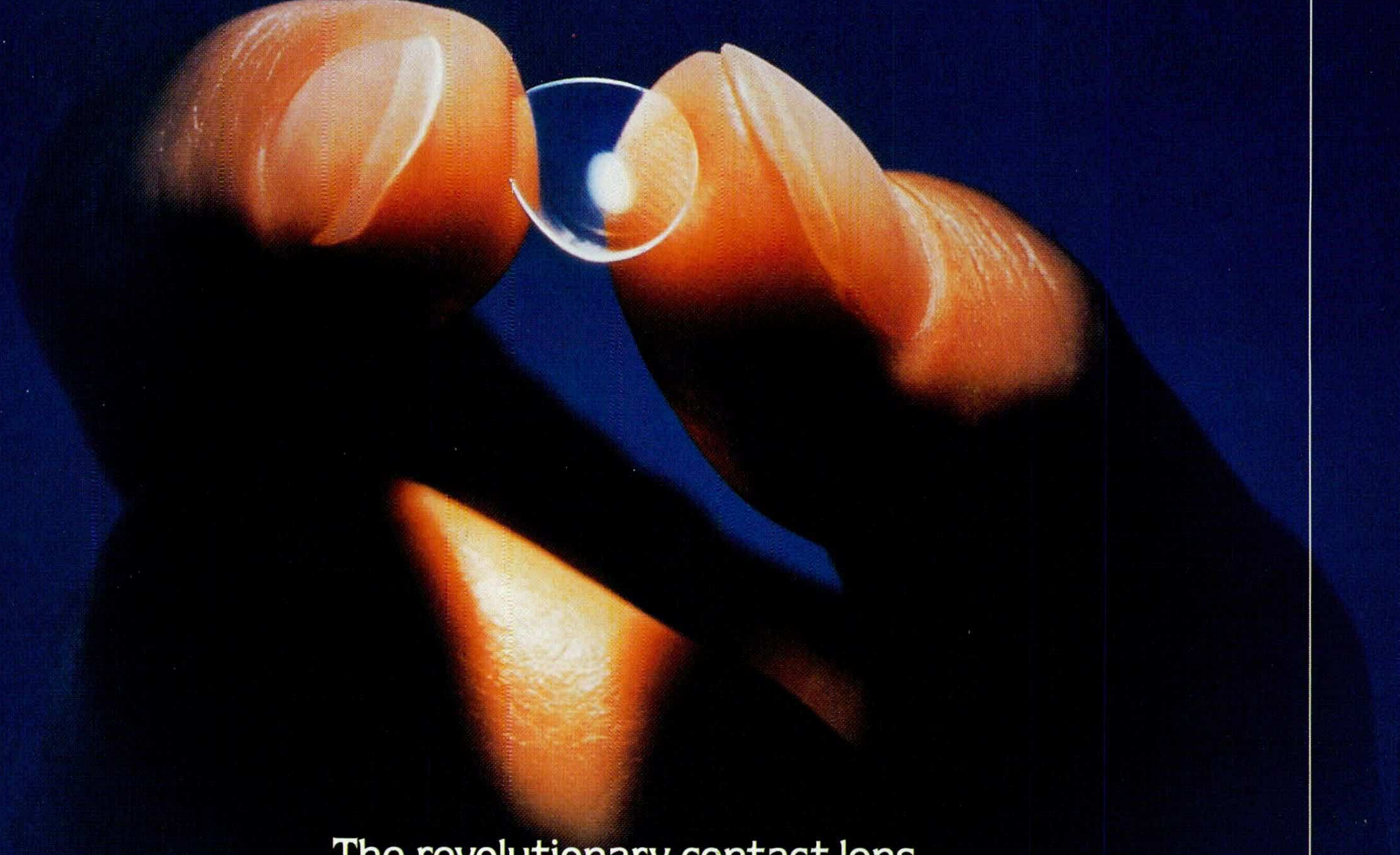

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