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INFANT VISUAL FIELD ASSESSMENT

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Abstract

A screen, called the "Baby Visual Field Screen" has been developed to assist with plotting and describing the visual fields of infants, toddlers and physically or mentally handicapped patients.

The screen is made of transparent perspex, is free standing, and is of similar dimensions to a one metre Bjerrum's screen.

During the examination the infant is seated on the parent's lap, one metre from the screen. Central fixation is elicited by one examiner behind the screen showing the subject a succession of toys, faces and/or talking to the infant as required. A second examiner introduces targets into the infant's peripheral visual field and moves them toward the centre, until the infant fixates the target or makes some sign of recognition. The targets were finger puppets of equal size and luminosity. The two examiners agreed on the point where the infant fixated the peripheral target and plotted this point on the screen. Horizontal, vertical and diagonal meridia were tested.

Monocular fields were plotted for twelve adults and twelve normal infants ranging in age from five to ten months and binocular fields for six infants of two and three months of age. Results indicate that the screen provides an accurate indication of a normal visual field. In a group of 13 infants and children at risk for visual field defects, the method was able to detect and record defects in five cases.

INTRODUCTION

Assessing and describing visual field defects in infants is a difficult task, but, as with adults, it can provide valuable information. Documentation of a visual field is important in describing the disability resulting from lesions of the visual pathway. This has implications in further therapeutic assessments, treatment and educational management.

Previously we have relied on confrontation techniques to estimate visual fields. In the multidisciplinary environment a more quantitative method has become necessary for more effective communication.

Complex technical equipment has been developed to study the visual fields of infants in a controlled environment. Mohn and Van Hof-van Duin[1] assessed the horizontal and vertical extent of the binocular visual field in 99 infants from birth to one year using a kinetic perimetry technique. The monocular visual field of 53 infants from six weeks to one year was also studied. The binocular visual field showed little development between birth and two months of age, but then expanded rapidly to the age of eight months and more slowly until twelve months. By this age the upper visual field had reached adult size while the horizontal and lower fields were still smaller

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than the adult. The development of the monocular visual field in the temporal and vertical direction closely resembled that of the binocular field but the nasal visual field was smaller than the temporal field at all ages.

Schwartz, Dobson, Sandstrom and Van Hofvan Duin[2] noted that neonates showed a larger visual field than 4 to 8 week old infants, however visual field shape was similar in infants and adults. Again a kinetic technique for perimetry was employed.

Mayer, Fulton and Cummings[3] have developed a static perimetry technique with LED stimuli and a forced choice observation procedure. Four central pulsating LED's were used to elicit central fixation and this was maintained with the aid of auditory stimuli. Adult observations of infants' eye movements to fix peripherally illuminated LED's were used to determine the extent of the field. The binocular visual fields of infants aged six to seven months were found to be similar to those of adults tested with the same apparatus. Monocular visual fields were smaller than those of adults. Mayer et al suggested this equipment had the potential to be a valuable clinical tool.

Maurer, Clarke and Lewis[4] used a similar static perimetry technique to demonstrate that the temporal visual field develops more rapidly than the nasal field.

The aim of the current study was to develop a clinical tool to improve the methods of reporting infant visual fields.

METHOD

Apparatus

The Baby Visual Field Screen was constructed by the Biomedical Engineering Department of The Children's Hospital, Camperdown.

The screen is made of a perspex sheet which is one metre square and three millimetres thick. It is mounted in a powder coated steel frame. Light alloy glazing bars locate and stabilize the screen within the frame. The complete assembly is mounted on casters, making the centre of the screen one metre from the ground.

The circles marked on the screen subtend angles of 5, 10, 15, 20, 25 degrees from a distance of one metre. An adjustable compass was used to scribe the circles into the screen about a fixed centre. It was specifically designed for this purpose and incorporated a cutting tool mounted on fixed rollers to engrave the perspex. Radial lines were scribed using the same cutter. Horizontal and vertical lines were first engraved, then the oblique at 15 degree intervals. "Scuff Stuff" boot polish was used to fill the engraved lines. Numbers were marked with "Letra-set".

Subjects

The Baby Visual Field Screen was trialed at Glebe Early Childhood Centre. Eighteen infants from two to eleven months of age with no known ocular defects were assessed following discussion about the trial with the Clinic Sisters and infant's parents.

A brief history of the infant's course to date and family details were obtained from the parents. Visual acuity was tested using Teller Acuity Cards and ocular posture was assessed. The results and data were within normal expectations for all infants.

The 12 infants aged five to eleven months all had monocular visual fields and visual acuity tests. The remaining 6 infants who were two or three months old were tested with both eyes open.

Monocular fields were assessed in 12 adults with corrected visual acuity of 6/6 or better and no history of ophthalmological or neurological problems.

The Baby Visual Field Screen was also used in 13 cases where the patient was "at risk" for having a field defect. There were a variety of neurological and ophthalmological problems involved with these patients.

Procedure

The screen was positioned in a quiet room with constant overhead fluorescent lighting. During the field examination infants were seated on the parent's lap one metre from the screen, with the infant's eyes aligned with the centre of the screen. (See Figure 1).

Figure 1: The infant, mother and examiner positioned behind the screen

The first examiner was positioned behind the screen, to attract the infant's attention and maintain central fixation, with her face or using toys. Auditory stimulation was sometimes employed to assist with a distractible infant. This examiner was the key observer in determining when the infant fixated the peripheral target and differentiated fixation movements from spontaneous eye movements. (See Figure 2)

The second examiner presented the finger puppet targets (green plastic monsters, approximately 3cm x 2cm x 3cm) placed on the end of

Figure 2: The examiner in front of the screen attracts the child's attention, and marks the point where peripheral fixation is made.

a tongue depressor. The targets were presented from behind the patient, into their peripheral field and moved toward the centre until the infant looked towards it. Horizontal, vertical and diagonal meridia were tested, using a kinetic technique similar to confrontation field examination.

When the infant looked towards the target, the first examiner moved to be 'in line' with it, and this peripheral point was marked on the screen using "Blue Tac".

During the testing, if inconsistency or "inaccuracy" was noted by either examiner, then immediate re-examination of that area was performed.

The entire procedure took approximately 20 minutes to complete monocular assessment, both right and left eyes; and 10 minutes when the tests were performed with both eyes open.

The adults in the trial verbally reported peripheral stimulus detection. All adults were tested monocularly.

RESULTS

Normal Infants

The fields resulting from testing with this technique demonstrated an increasing field size with age. These results are similar to the visual field development studies of other groups, who utilized kinetic techniques.[1]

For analysis the trial population has been divided into age groups. The binocular fields of

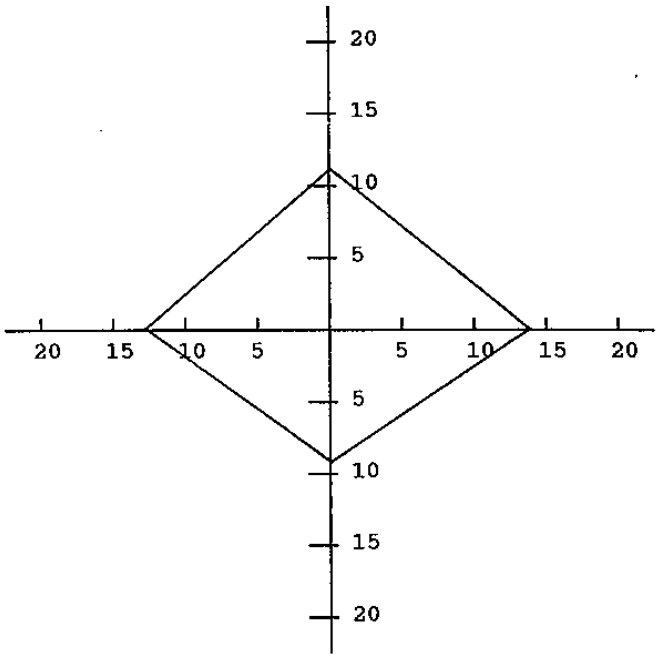

Figure 3: Binocular Visual Fields of Normal Infants less than 3 months old. Mean values at 0 deg, 90 deg, 180 deg, 270 deg.

infants aged less than three months were plotted using the mean values of horizontal and vertical meridia (Figure 3). The monocular fields were grouped into three to six months, six to nine months and nine to twelve months. The right and left eyes were considered separately and plotted, again using the mean values of the horizontal and vertical meridia. (Figure 4)

The mean values for adult eyes are shown in Figure 5.

"At Risk" Patients

The 13 "at risk" patients were tested using the same procedure. In many cases, more vigorous methods were employed by the examiner to ensure central fixation. This was necessary when the patient's state of health was poor or when a defect became apparent, making the test more time consuming.

Visual field defects were demonstrated in 5 of the 12 cases who were considered to be "at risk". A left hemianopia was found in a 4 1/2 year old child with cerebral palsy, a small right cerebral hemisphere and postinfarct and haemorrhagic changes. An 8 month old infant who had suffered a severe head injury causing an occipital intracranial haemorrhage had a right hemianopia. Sturge Weber Syndrome had caused extensive calcification of the left cerebral hemisphere in a 1 year old infant, resulting in a right hemianopia. A post-encephalitis victim was found to have a left hemianopia at 3 1/2 years of age. A 4 year old child who suffered a left cerebral vascular accident during cardiac surgery had a right superior temporal quadrant deficit in the right eye, and a nasal field deficit in the left eye.

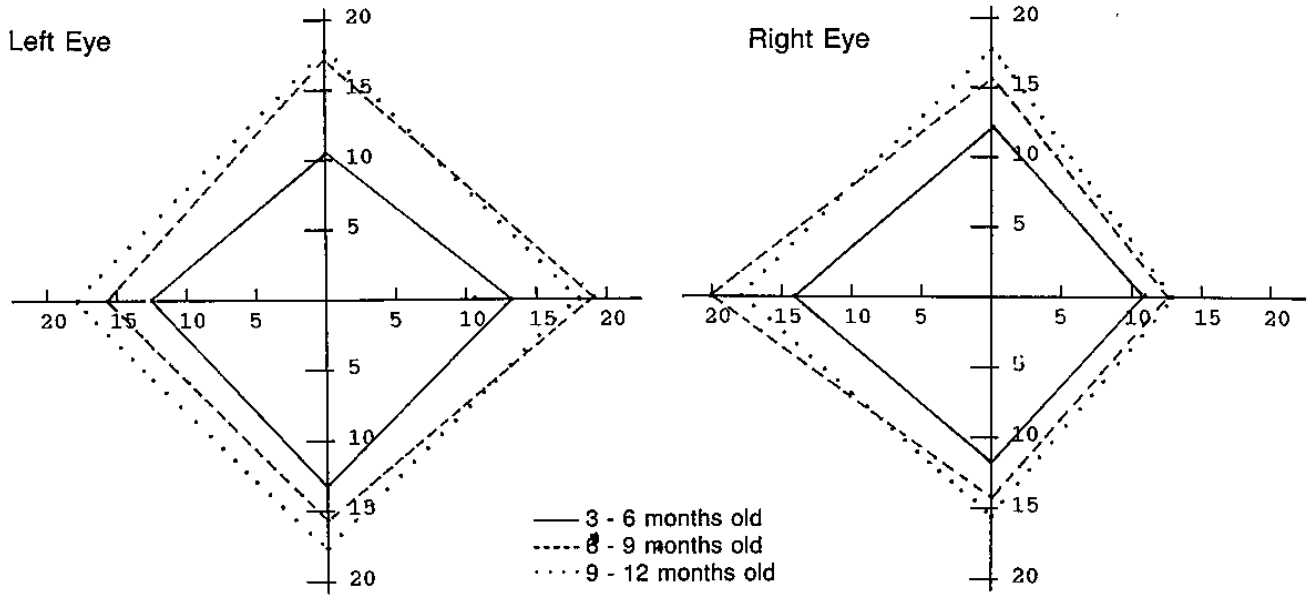

Figure 4: Monocular Visual Fields of Normal Infants 3-12 months old. Mean values at 0 deg, 90 deg, 180 deg, 270 deg.

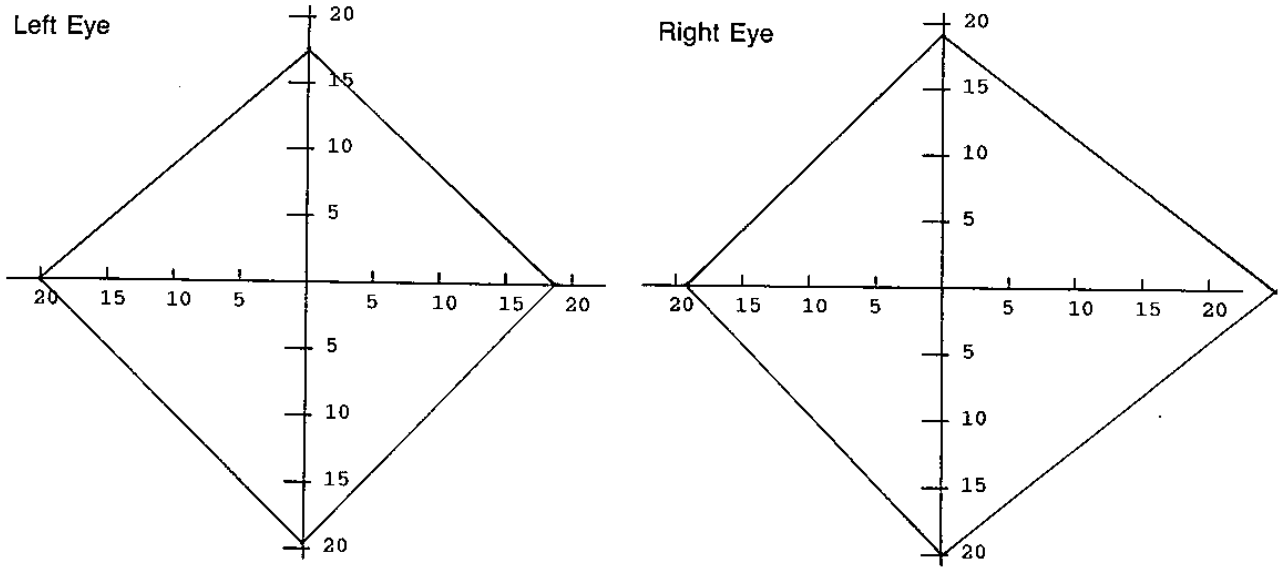

Figure 5: Monocular Visual Fields Normal Adults. Mean values at 0 deg, 90 deg, 180 deg, 270 deg.

The remaining 7 patients tested using the Baby Field Screen were not found to have a visual field defect. This group included a 3 year old with cerebral palsy; two children who had suffered severe head injury, (one aged 7 years, the other aged 11 years); one 3 year old with bilateral colobomas of the disc, retina and choroid; a developmentally delayed 2 year old child; a case of benign intracranial hypertension affecting a 3 year old; and a 7 year old with bilateral optic nerve gliomas.

DISCUSSION

The Baby Field Screen proved to be a convenient clinical tool to assess and document the visual fields of infants and children. Numerous advantages of the system became evident.

The Baby Field Screen is clearly not as refined as the techniques previously discussed.[1,2,3,4] This procedure for infant visual field assessment is designed for easy clinical application to detect and plot "gross" visual field defects in patients unable to co-operate with more sophisticated methods. The major improvements over traditional confrontation testing are the more accurate plotting of the fields enabling demonstration of the field defect to the parent/caregiver, giving them a better understanding of the limitations of the condition.

Two examiners were required to perform the test. This was found to be beneficial. Consultation between the two examiners ensured that the screen was marked accurately at the point of the infants fixation. This allows the opportunity to differentiate spontaneous eye movements and true fixation. The techniques involved in assessing and observing are readily learned by skilled orthoptists.

Co-operation was readily gained from the normal subjects and the 'at risk' patients. This could be attributed to the testing procedure being approached as a game. The importance of this approach was evident when testing acutely or chronically ill children who had previously undergone many invasive procedures. Their confidence was gained when they realised that this procedure was non-threatening. When necessary children in both groups were pacified with the help of a dummy, by holding a toy or by comfort from a parent. Maintaining central fixation was more easily achieved in the normal group.

It is envisaged that the Baby Field Screen test has further applications with patients who are not mentally or physically capable of performing alternative visual field tests. This information may aid further therapeutic assessments, treatment, rehabilitation and educational

management in handicapped children, disabled adults and stroke patients.

The procedure is effective due to its simplicity and speed. The screen itself is portable, durable, requires only a small area for use and does not need electricity for its operation.

Overall, the baby visual fields appeared similar in size to the adult fields by the 9-12 month age group, a finding which is similar to Mohn et al[1] and Schwartz et al.[2] Monocular testing of infants tended to show slightly larger nasal fields which is in contrast to Mohn et al[1] and Maurer.[4] Our results may well be due to the small sample size, and by examining the results too closely in a test where the variables are great and difficult to control. Such variables include the overall alertness of each individual child throughout the test procedure, the exact position of the central fixation target and frequent change of target (which was usually moved a little and swapped with other targets to promote sustained interest). Also, the hand held peripheral target may have varied in its speed of approach and exact distance from the screen on approach to the centre of the visual field. This is due to slight variations in distances from the screen to the peripheral target when examiners try to manoeuvre around different subjects without the examiner becoming too obvious to the subject. Examiner bias is not believed to have contributed to the results, as examiners did not have a fixed role in the testing procedure.

Clearly, the documentation of a visual field defect in the "at risk" patient group provides valuable information of these patients' conditions. The technique allows accurate plotting of defects such as hemianopia and quadrantinopia. Defects, such as those due to enlargement of the optic disc or coloboma, which may be plotted in co-operative patients using sophisticated methods, can not be recorded with the Baby Visual Field Screen.

CONCLUSION

The Baby Visual Field Screen provides a significant improvement in describing the visual field defects of infants and small children. It is useful in the clinical setting, allowing a rapid, effective and non-threatening assessment. The resultant information is meaningful for the examiners, medical team, therapists, educationalists and parents/caregivers.

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