Feasibility of computerized confrontation perimetry in young infants.

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Introduction

It is known that the visual field is immature at birth and reaches the adult's extent only around the age of 3 years (Tronick 1972, Harris and MacFarlane 1974, Dobson & al, 1998). Standard automated perimetry may be feasible with some previous familiarization for children between 5 and 8 years of age (Safran & al, 1996). However, it requires a degree of understanding and cooperation that is not available at younger ages, particularly in children with handicaps. In those cases, confrontation perimetry remains the only possible solution.

Several previous studies have proposed an objective recording of eye movement responses during confrontation perimetry:
- Verriest & al (1985) used an electro-oculographic (EOG) recording technique.
- Nagata & al (1989) used a recording based on video oculography (VOG) with a camera placed on a head helmet detecting the movements of the reflection of a light source on the cornea
- Murray & al (2009) used an eye tracker placed under the stimulus display monitor to measure the eye movements from the position of the reflection of a light source over the cornea relative to the pupil of the eye.

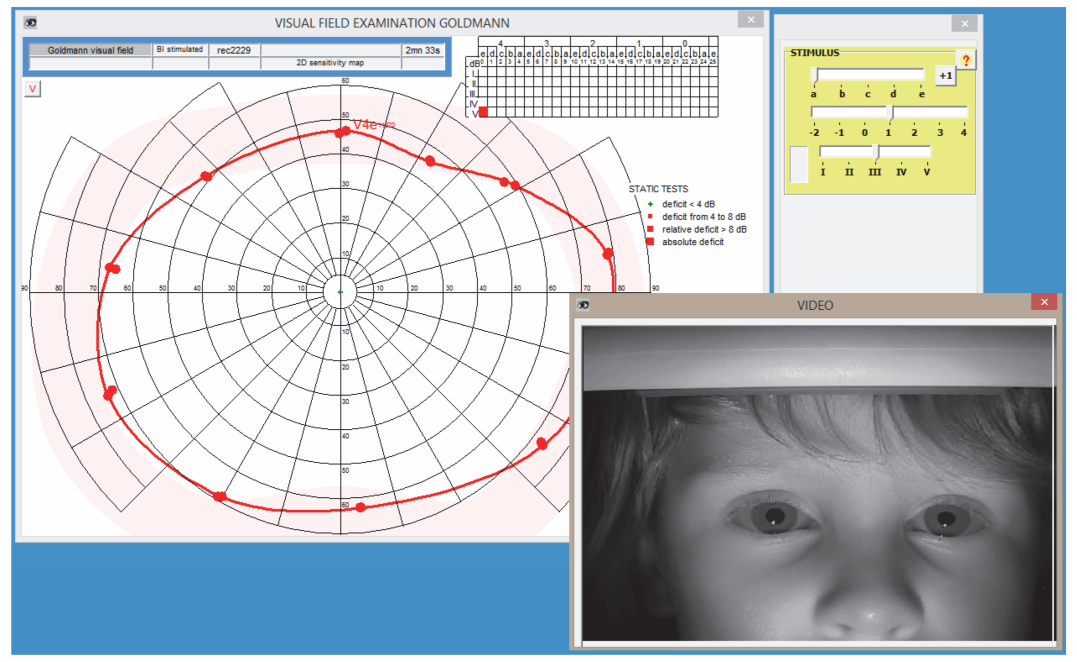
The EOG technique requires electrodes placed on the outer canthus of the eyes. It presents several major disadvantages: the electrodes are poorly tolerated by infants and, above all, eye movements are recorded relative to the head and therefore cannot provide a reliable response for children who turn the head instead of turning the eyes.
The VOG technique proposed by Nagata & al has the same disadvantage than the previous system: the helmet is poorly tolerated and the recorded movements are related to the head.
The VOG technique proposed by Murray & al eliminates this problem by having the eye tracker placed under the stimulation display. However the size of the display monitor limits the evaluation of the visual field to its central part.

Purpose

The purpose of this study was to evaluate the feasibility of detecting behavioral responses on young children, below the age of 5 years, during full field visual field exams.

Methods

The study involved the analysis of 12 visual field results which were part of the assessment of infants with neuro-ophthalmology disorders. Infants' ages ranged from 12 to 60 months (median value 42).
The visual fields were performed binocularly on a MonCvONE full field computerized perimeter (Metrovision, France).
The behavioral responses of the tested subject were recorded with a camera viewing the subject's face through a small opening of the stimulator cupola. The size of the camera field of view (12 cm) allowed both eyes to be recorded at the same time as well as the recording of head movements.
With the mouse interface the operator controlled the presentation of tests (Goldmann V-4) first at the center of the screen to attract attention then in the periphery.
The entire examination process (stimulus size, luminance and position) were recorded in synchrony with the video of the subject's face.



View of computer interface
(a) control of stimulation parameters (b) display of video (c) selection of stimulus and response positions

The operator interpreted the subject's behavior from the video of the head and noted if an orientation response was present. The same protocol was repeated along 12 meridians.
The first part of the study, a second experienced operator re-evaluated the subject's responses by analyzing "off line" the videos recorded throughout the exams (the stimulus was displayed in overlay with the video).
In a second part of the study, the operator determined if the corneal reflections and the pupils could be detected and be used as a clue for response detection.

Author Disclosure Block

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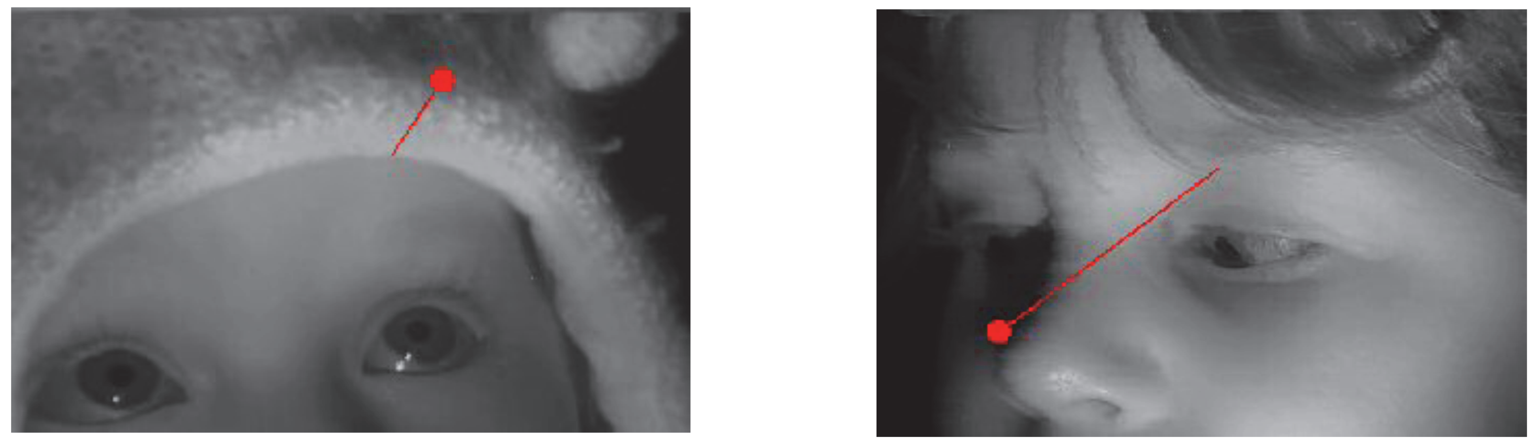
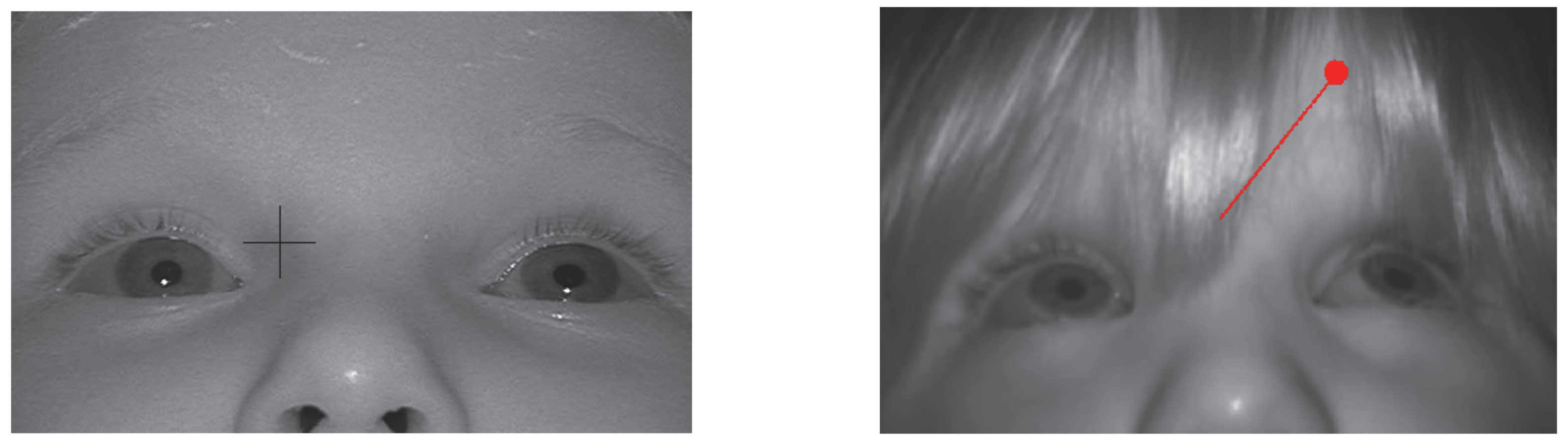
Results

For the evaluation of orientation responses, there was an excellent agreement (better than 95 percent) between the 2 operators.

Over a total of 170 recorded responses, 112 (65 percent) allowed a detection of the pupil movement. The pupil response was not detected reliably in most cases of large nystagmus, or when the test was presented in the lower visual field (due to masking by the eye lids) or when the orientation response involved a large cephalic movement. The corneal reflection was not detected for eye movements exceeding 25 – 30 degrees of eccentricity.



View of recorded video with overlaid stimulus position
(left) eye movement response(b) display of video (c) head turning response



(left) child fixating the stimulus presented in the center of the field:
the corneal reflection and pupil are easily detected
(right) child fixating the stimulus presented in the upper visual field:
the corneal reflection is no longer detected.

Conclusions

Computerized confrontation perimetry can improve the evaluation of the visual field in young infants by providing an objective recording of the examination process in synchrony with the video.
In a large percentage of clinical cases, the classic clues used to detect eye movements (movements of the corneal reflection and of the pupil) are not reliable when the tests are presented at large eccentricities.
Experienced operators are then needed for the interpretation of orientation responses and also to interact with the young subjects and maintain their cooperation during the exam.

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