Civic Center Exhibition Hall
Thursday 8:30 AM — 1:00 PM

Eye Movements, Strabismus & Amblyopia
Eye Movements/Visual Direction

MODERATORS: Harold E Bedell
D. Alfred Owens

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THE MEASUREMENT OF PUPIL CYCLING TIME

Peter Alan Howarth, Department of Human Sciences, Loughborough University of Technology, Leicestershire, LE11 3TU, England

When a slit lamp is shone at the edge of the pupil, "cycling" occurs: the pupil constricts and dilates repetitively as the iris alternately allows the light to reach the retina, and then prevents it from do so. Cycling time will depend upon the transmission time of the pupillary nerves, and it has been suggested that this measure could differentiate between normal and diseased eyes. However, the between-study difference in "normal" values is larger than the reported differences between normal and diseased eyes.

The measurement procedure for determining cycling time has not been standardized, and this lack of standardization will lead to, for example, the slit lamp being positioned closer to the centre of the pupil for a small-pupilled patient than for a large-pupilled one. To examine whether cycling time is independent of the measurement procedure, four subjects were measured using a modified infra-red pupillometer. The pupillometer controlled the stimulus: an LED positioned in front of the eye was turned off if the pupil area was below a "threshold setting", and turned on if it was above this value. By varying the threshold setting, variation in slit-lamp position was mimicked. Each subject showed a monotonic increase in cycling period with an increase in threshold setting, and by manipulating the lighting levels and threshold, the cycling period could be *doubled*.

The change of period with change in threshold setting shows that there will be a longer cycling time the further from the centre of the pupil a slit-lamp stimulus is positioned. This could explain why there is such a large difference between the reported "normal" values from different studies, and points to the need to standardize procedures if the test is to have any validity.

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CLINICAL PUPILOMETRY SYSTEM RUNNING UNDER *MS-WINDOWS*.

W. James MacLean, M.A.Sc., Richard C. Frecker, M.D. Ph.D. Visual Sciences Laboratory, Institute of Biomedical Engineering; and Departments of Pharmacology, and Electrical Engineering, University of Toronto, Toronto, Canada. M5S 1A4.

A PC-based pupilometry system has been developed for clinical use. System hardware comprises a 25-MHz 386 with math coprocessor, 4 MB of memory, a *Data Translation* DT2853 frame grabber, a *Panasonic* GP-MF200 CCD video camera (with IR illumination diodes mounted on lens barrel), and a *Panasonic* TR930B monochrome video monitor. The software is written in *Microsoft C* to run under *Windows 3.0*, and is therefore fully mouse supporting. The system was designed to be easy to operate and includes complete on-line help using the *Windows* help facility.

The operator aligns the subject in an optical frame, and focuses the video camera. The system captures an image of the eye, and processes the image to extract pupil size and boundary information. Use of *Windows* allows direct access to the PC's extended memory, thereby permitting more memory and speed for intermediate image processing steps. Image processing takes about 60 seconds, and involves: smoothing; Sobel edge extraction (including gradient information); thresholding (using a histogram technique); modified *Hough* transform (to detect pupil boundary); estimation of pupil radius using a histogram technique; and, removal of extraneous image points (using gradient information and pupil diameter estimate). The residual image consists only of the pupil boundary points (PBP's). The *Hough* transform is modified to look for circles with dark centres (which are of a realistic size for a pupil) and to remove extraneous points.

Camera calibration is an automated procedure in which the operator images a pre-defined matrix of points. The software calculates a conversion factor to map image points to millimeters. Typical resolution is 0.02 mm/pixel. Total image coverage is 1 cm square. Pupil diameter is easily estimated using a linear least-squares estimator. Root mean square error is typically less than 5 pixels (0.1mm), keeping in mind that this also includes irregularity of pupil shape. PBP coordinates are saved in a data file, along with analysis results and subject information, for later manipulation and statistical analysis.

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THE USE OF DAPIPRAZOLE TO REVERSE PUPIL DILATION: A CLINICAL STUDY.

Charles G. Connor, J. Bart Campbell & Wylie W. Tirey Southern College of Optometry 1245 Madison Ave. Memphis, TN 38018.

This study reports on the utility of Reveyes (dapiprazole HCL) for reversing pupil dilation. In this double masked study 79 subjects were dilated with 1 drop each of: 0.5% proparacaine, 2.5% phenylephrine & 1% tropicamide. The subjects ranged in age from 21 to 40 (mean 25), 70% were male, no presbyopes were included. After the patients were fully dilated (45 min.); 4 drops of Reveyes or placebo (5% NaCl) were instilled in each eye. By 60 min. post instillation no significant differences were observed when the groups were compared. After 2 hrs. changes were noted in both groups. The near visual acuity improved from 20/100 to 20/20 in the Reveyes group while the control went from 20/100 to 20/25. The Reveyes group showed reaction to light sooner (2+ vs NR) and smaller pupils (6 vs 8 mm) but the amplitude of accommodation was the same for both groups (9D). No change in distance acuity or IOP was observed for either group. Our data suggest the benefit to the patient of Reveyes is minimal especially in light of the side effects of burning on instillation and intense conjunctival flush. Only 57% of our subjects said they would like to use Reveyes again to reverse their dilation. A statistical analysis of the data and the subject reported side effects will be presented.