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PURPOSE: We sought to derive perimetric measures from the responses of pupils to novel spatial and temporal patterns of dichoptic multifocal visual stimuli; we then investigated whether the measures could distinguish 23 subjects in the early stages of type 2 diabetes from 23 normal subjects.

METHODS: We used a proto-type of the Truefield Analyzer to deliver a multifocal sequence of flashed stimuli to both eyes at the same time. This device uses a stereoscopic pair of LCD displays to deliver pseudo-randomly modulated arrays of light stimuli to multiple regions of each retina while pupil responses are recorded with infrared cameras. The multifocal stimuli covered 44 regions per eye and induced variations in pupil diameter which were measured over 8 segments of 30 s. The method was largely immune to the effects of blinks and fixation losses. Applying multivariate statistics, we then examined whether the pupil responses of the diabetic patients could be reliably discriminated from those of normal subjects. We examined the n-worst constriction amplitudes, time to peak, and linear combinations of those.

RESULTS: Dichoptic multifocal pupillometry provided robust plots of pupil contraction versus post-stimulus time for each stimulus region. These region-by-region constrictions were reliable, giving median z-scores of 2 to 3. Responses of the normal and diabetic subjects were statistically different, particularly for the combined time and amplitude measures. The diagnostic performance (expressed as areas under ROC plots) for the 8 subjects (16 eyes) who had been diagnosed with type 2 diabetes for at least 10 years was 0.89 ± 0.06 (mean ± SE), rising to 0.97 ± 0.03 when between-eye asymmetry was considered.

CONCLUSIONS: In a pilot study of 23 patients diagnosed with type 2 diabetes, dichoptic multifocal pupillography produced perimetric measures that were statistically different to those seen in matched controls, especially for those who had had the disease for more than 10 years. This result, if confirmed in a wider group, suggests that the method may be clinically useful.

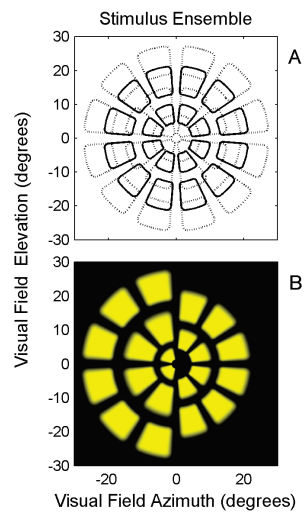


Figure 1. The stimulus array had 44 regions as indicated by all the contours in Fig. A. B shows the two sets of slightly overlapping stimuli in the 44 element array on the left and right halves.

All the stimuli were yellow, the background and maximum luminances were 10 and 290 cd/m², and the stimulus duration on each presentation was 33 ms.

Above: TrueField Analyzer, can be seen at Trade Booth 822

Variable	dB	SE	t-stat	p
Reference	10.4	0.13	78.1	5.3E-315
Consensual	-0.43	0.04	-9.98	2.20E-23
Female	0.43	0.04	10.0	1.40E-23
NIDDM	0.29	0.04	6.85	7.50E-12

Table 1. Independent effects on pupil contraction amplitudes estimated by a linear model. The reference (grand mean) response amplitude is 10.4 dB, and the three other factors show deviations from that value (positive values represent an increase), and the significances of those deviations from the reference condition.

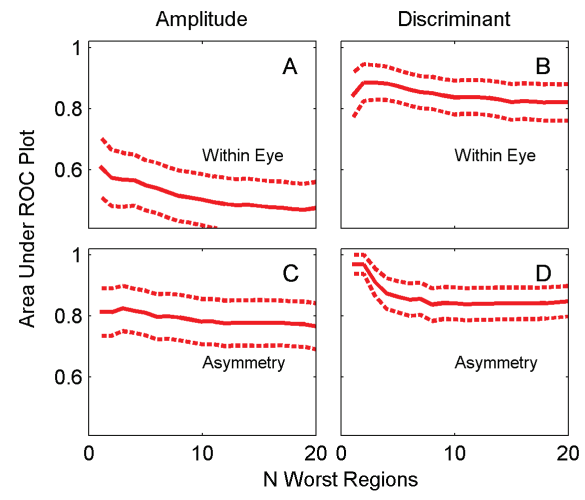


Figure 2. ROC area (AUC) ± SE plotted as a function of the mean of the N worst regions from 46 normal eyes compared to the means of the N worst regions of 16 eyes with NIDDM for 10 or more years. The two variables considered are constriction amplitude (A,C) and a discriminant function combining amplitude and delay (B,D) of Table 4. The within-eye case examines deviations from mean normal data for each visual field region. In the asymmetry case, the differences between the left and right fields at each location are considered.

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