Prevalence of characteristic pattern and location of glaucomatous initial visual field defects

Purpose: To describe and enumerate the characteristic pattern and location of initial visual field defects (VFD) on 24-2 VF in a glaucoma cohort.

Methods: Records of 69 patients' data (76 eyes) were reviewed from 2008 to 2019: (66 primary open-angle glaucoma and 10 primary angle-closure glaucoma eyes). Patients (mean age 66±10yrs) with glaucomatous optic neuropathy and baseline SITA-standard 24-2 VF with stable and repeatable VF damage were included. VF defects with a mean deviation (MD) better than -7dB were included and categorized into eight groups based on four consecutive initial VFDs: (1) superior central visual field defects (CVFD), (2) inferior CVFD, (3) superior nasal defects (ND), (4) inferior ND, 5) superior arcuate defect, 6) Inferior arcuate defect, 7) superior partial arcuate defect and 8) inferior partial arcuate defect. Horizontally, CVFD was for points lying from 0 to 10 degrees; ND was for points beyond 20 degrees. MD, PSD values were analysed for each subgroup to identify possible associations.

RESULTS: In POAG, frequent initial VFDs were ND, CVFD, and arcuate-like defects: superior ND (31.8%), inferior ND (27.3%), superior CVFD (30%), and superior arcuate-like defects (24%); the next most common VFD were inferior partial arcuate (23%). In comparison to POAG, ND was more frequent as initial VFD in PACG (superior 40% and inferior 50%) but the incidence of any CVFD was only 10%. Both the hemifields were affected in 26.3% of eyes where 65% of them were ND and 19.7% of eyes had more than one type of defect. CVFDs were more common in the superior hemifield (p=0.04). Relatively younger patients (62.5±9.6) presented with ND (p=0.03). Interestingly, no PACG patient presented with any arcuate-like defect in superior hemifield (0%). However, in eyes with POAG, arcuate-like defects were present with significantly higher PSD (arcuate = 6.4dB ± 2.3, p=0.01 and partial arcuate= 5.2 dB ± 2.2, p=0.04).

Conclusions: In PACG, ND was more frequent as the initial VFD and patients are relatively younger, while in POAG, initial defects were ND, CVFD, and arcuate-like defects. Prevalence of more than one type of defect and involvement of both the hemifields were not uncommon in both groups. Moreover, in POAG, severe glaucomatous defects like CVFD and arcuate-like defects with higher PSD were observed in superior hemifield even as initial VFD.

Short-term visual field improvement after initial intraocular pressure lowering therapy in newly diagnosed glaucoma - evidence from a randomised, multicentre placebo-controlled trial (UKGTS)

Purpose:

Evidence to support the hypothesis that visual field (VF) status can improve after initiation of intraocular pressure (IOP) reducing treatment is controversial and equivocal. We take advantage of participant screening data from the United Kingdom Glaucoma Treatment Study (UKGTS) to test this hypothesis in newly diagnosed glaucomatous patients randomised to IOP lowering therapy or placebo.

Methods:

Screening data, including two reliable VFs (Humphrey 24-2 SITA Standard) and two IOP measurements (Goldmann), were used to determine eligibility to UKGTS. These data were available in 414 participants with 302 and 299 eligible eyes randomly allocated to IOP lowering treatment (latanoprost) or placebo respectively. We compared these data to trial baseline data with the latter acquired after allocation to treatment or placebo. Main outcome was mean change in VF mean deviation (MD) during this short interval and proportion of eyes that improved MD by more than 1dB. Secondary analyses included stratifying the cohorts by level of IOP, VF loss and age along with total deviation (TD) pointwise analyses including change in a subset of five locations with the greatest improvement in sensitivity (dB) within each eye.

Results:

Mean (standard deviation [SD]) time between screening and baseline visits was 13 (7) weeks. Mean (SD) MD of all the eyes at baseline was -3.84 (2.88) dB. Mean (SD) reduction in IOP was -4.75 (4.05) and -0.87 (3.40) mmHg for the treated and placebo eyes respectively. Mean (SD) change in MD was +0.10 (1.49) and +0.19 (1.67) dB for the treated and placebo eyes respectively; these differences were not statistically significant (p=0.50). The same proportion of eyes improved their sensitivity by at least 1dB on MD in this period, 24% for treated and 25% for placebo eyes. Stratifying the data by age, level of VF loss (MD) and IOP did not reveal any differences between the treated and placebo eyes (Table 1).

	Mean (SD) change in MD (dB) **treated**	Mean (SD) change in MD (dB) **placebo**	Significance (p)
Youngest	+0.21 (1.41)	+0.44 (1.87)	0.33
Oldest	+0.14 (1.42)	-0.07 (1.59)	0.33
least VF damage	+0.23 (1.79)	+0.69 (2.34)	0.12
most VF damage	-0.01 (1.29)	-0.28 (1.12)	0.12
Lowest IOP	+0.09 (1.31)	+0.35 (1.78)	0.25
Highest IOP	-0.17 (1.90)	-0.21 (1.60)	0.89

Table 1: Changes in MD in the highest and lowest tertile of age, screening visit MD and screening visit IOP.

The five VF locations in each eye with the greatest improvement in TD had mean (SD) change of +10.46 (6.74) and +9.95 (6.55) dB for treated and placebo eyes respectively; indicating no statistically significant difference (p=0.35).

Conclusion:

Short term VF changes were no different in eyes receiving IOP lowering therapy compared to those receiving placebo. In these newly diagnosed patients (non-advanced glaucoma) we found no evidence to support the idea that the VF status suddenly improves after initial lowering of IOP.

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Disclosures
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Preferred form of presentation: paper or presentation

Title: Perimetric testing of patients with ocular hypertension in the English Hospital Eye Service

Authors: Stephen R. Kelly, Anthony P. Khawaja, Susan R. Bryan, David P. Crabb

PURPOSE:

There are more than one million visits in the English and Welsh National Health Services each year from patients with glaucoma or glaucoma-related conditions. With an ageing population and an increase in the amount of perimetric testing being carried out, the economic burden of these conditions is predicted to increase. The purpose of this study is to use a large visual field (VF) database to examine the progression of patients with ocular hypertension (OHT) to perimetry-detectible VF loss.

METHODS:

The study population consisted of 45 309 patients from five regionally different glaucoma clinics in England. Retrospective electronic medical records such as VF tests, IOP measurements, diagnostic labels and treatments were included. The progression to VF loss was calculated and Cox proportional hazard models were used to examine factors associated with progression. The frequency of VF testing for glaucoma suspects, patients with OHT and POAG were then compared.

RESULTS**:**

The overall five-year progression rate for OHT patients was 17.5% (95% CI: 15.4% to 19.6%). Patients who were on IOP-lowering medications progressed at a lower rate compared to those not on treatment (HR: 0.45, 95% CI: 0.35 to 0.57). The median number of months between VF tests for glaucoma suspects, OHT and POAG patients was 10.9, 9.7 and 9.6 respectively.

CONCLUSION**:**
It is feasible to use a large database of routinely collected glaucoma clinic data to audit aspects of VF testing. We have shown that those labelled as glaucoma suspects, OHT patients and POAG patients receive a similar frequency of perimetric testing, highlighting a lack of risk-based stratification in testing intervals.

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Conflict of interest: There is no conflict of interest.

Title: Influence of Myopic Correction and Axial Length on ON-OFF Perimetry

Purpose: To investigate how the function of ON and OFF visual pathways are affected by myopic refractive error, axial length, and eccentricity.

Methods: Thirteen eyes of 13 human subjects (23-30 years old; mean 25.4 +/- 1.99) were tested at 8 Michelson contrast levels (5-20%) out to 30 degrees from fixation fully corrected in soft contact lenses. A single test comprised of 579 trials (27 catch trials), at 92 locations, repeated 3 times for light and dark stimuli at 8 contrasts levels (4,632 trials).

Hardware consisted of a head mounted display with an eye tracker (HTC VIVE embedded Tobii) with a refresh rate of 90 Hz, a maximum luminance of 110 cd/m2. Stimuli were light or dark squares on a spherical binary noise background. Stimulus size increased as a function of eccentricity using a power law relationship. Unity (version 2017) software was used to generate stimuli.

Eye movements were measured at 120 Hz and restricted within a central 2.5-degree radius circle. Percent of correct responses were measured across the entire visual field and, separately, for each of 6 annual eccentricities 5-10°, 11-20°, 21-30° from fixation. Percent response errors were plotted as a function of refractive error and axial length for the entire 30° and for each specific eccentricity.

Grand Seiko WAM-5500 autorefractor was used to measure residual central and peripheral refractive error. Measurements taken in primary gaze and approximately 22.5° from center at 45°, 135°, 225°, and 315° quadrants in 9 of 13 subjects thus far to account for impact of residual peripheral blur of ON-OFF eccentric perimetric stimuli.

Results: There was a significant positive correlation between axial length and percent response errors across the entire testing area (r= 0.4421, p=0.0185). This was most pronounced at 21-30° eccentricity (r=0.5272, p=0.0039). There was a significant negative correlation between refractive error and percent response errors only at 21-30° eccentricity (r value = 0.402, p = 0.034, between 21-30°). Overall, subjects responded more accurately for dark than light stimuli (13.82 ±7.22 versus 15.00 ± 7.91, p= 0.0367). This was most pronounced at 21-30° eccentricity (p=0.0023). Average residual peripheral refractive error in spherical equivalent was –0.46 D ± 1.10 compared to average central refractive error -0.24 D ± 0.40.

Conclusion: Decreased accuracy to ON-OFF perimetric stimuli in myopic patients is more closely correlated to axial length than refractive error.

Attached image:

Figure 1. Percent of all errors as a function of axial length at 21 to 30 degrees eccentricity from fixation in visual field.

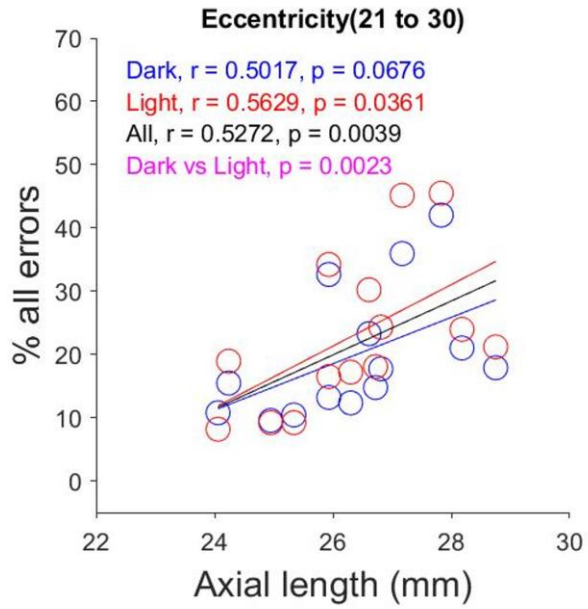
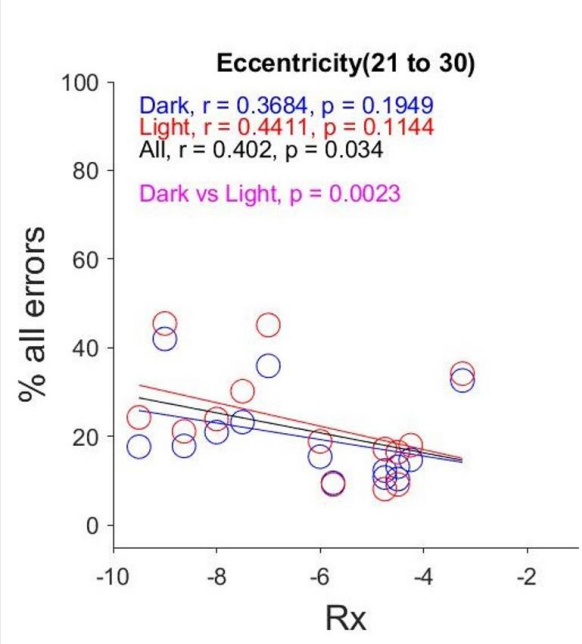


Figure 2. Percent of all errors as a function of refractive error 21 to 30 degrees eccentricity from fixation in visual field.



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Conflict of interest: There is no conflict of interest.

(TITLE)
Influence of Open Angle Glaucoma on ON-OFF Perimetry

(PURPOSE)
To compare the effect of glaucoma on the percent error response using ON-OFF pathway perimetry and results derived from static automated perimetry (SAP).

(METHODS)
Fourteen eyes from 14 subjects, 7 with glaucoma (48-76 y/o; mean, 64 ± 10.28; MD -0.48 to -18.25) and 7 controls (48-78 y/o; mean 65.14 ± 9.63) were tested at 8 Michelson contrast levels (5-20%). ON-OFF perimetry results were compared with SAP threshold values obtained from commercially available software and an analysis of the 10 most sensitive points of the temporal quadrants was performed in both study groups.

A single ON-OFF perimetry test included 579 trials (27 catch trials), in 92 locations, repeated 3 times for both light and dark stimuli at 8 contrast levels (4,632 trials). Hardware consisted of a head-mounted display with an eye tracker (HTC Vive Pro Eye, 90Hz, maximum luminanace:110 cd/m^2). Stimuli were light or dark squares presented on a binary noise background. Stimulus size changed as a function of eccentricity using a power law relationship.

Unity software (version 2017) generated the stimuli. Eye movements were measured at 120 Hz and restricted to a central 2.5-degree radius for controls, 3.5 for glaucoma patients. Percent correct responses were measured and differences between controls and glaucoma subjects were plotted as a function of glaucoma severity.

SAP data were analyzed using HVF deviation plots and means of the 10 most sensitive points in both temporal quadrants of glaucoma subjects and were compared to age-matched controls.

(RESULTS)
There was a positive correlation between the control-glaucoma subject difference in percent correct responses measured with ON-OFF perimetry and sensitivity of glaucoma subjects measured with SAP for both the full visual field ($r= 0.7351$, $p= 0.0027$) and the quadrant most affected by glaucoma ($r= 0.58$, $p= 0.0297$) (Figure 1). Between each pair of subjects, the percent error rate was greater for the glaucoma subjects for the full visual field and each temporal quadrant, whether or not they were flagged as significantly deviating from the SAP reference data base. This finding was corroborated by the mean difference analysis of the 10 most sensitive points ($p \leq 0.025$) in all but 2 temporal quadrants of 2 control-glaucoma pairs (Table 1).

(CONCLUSION)
The presence of glaucoma increases the percent error response within the central 30 degrees of ON-OFF perimetry vs age-similar controls. This was evident across the entire visual field and within quadrants associated with glaucomatous visual loss.

Attached images:

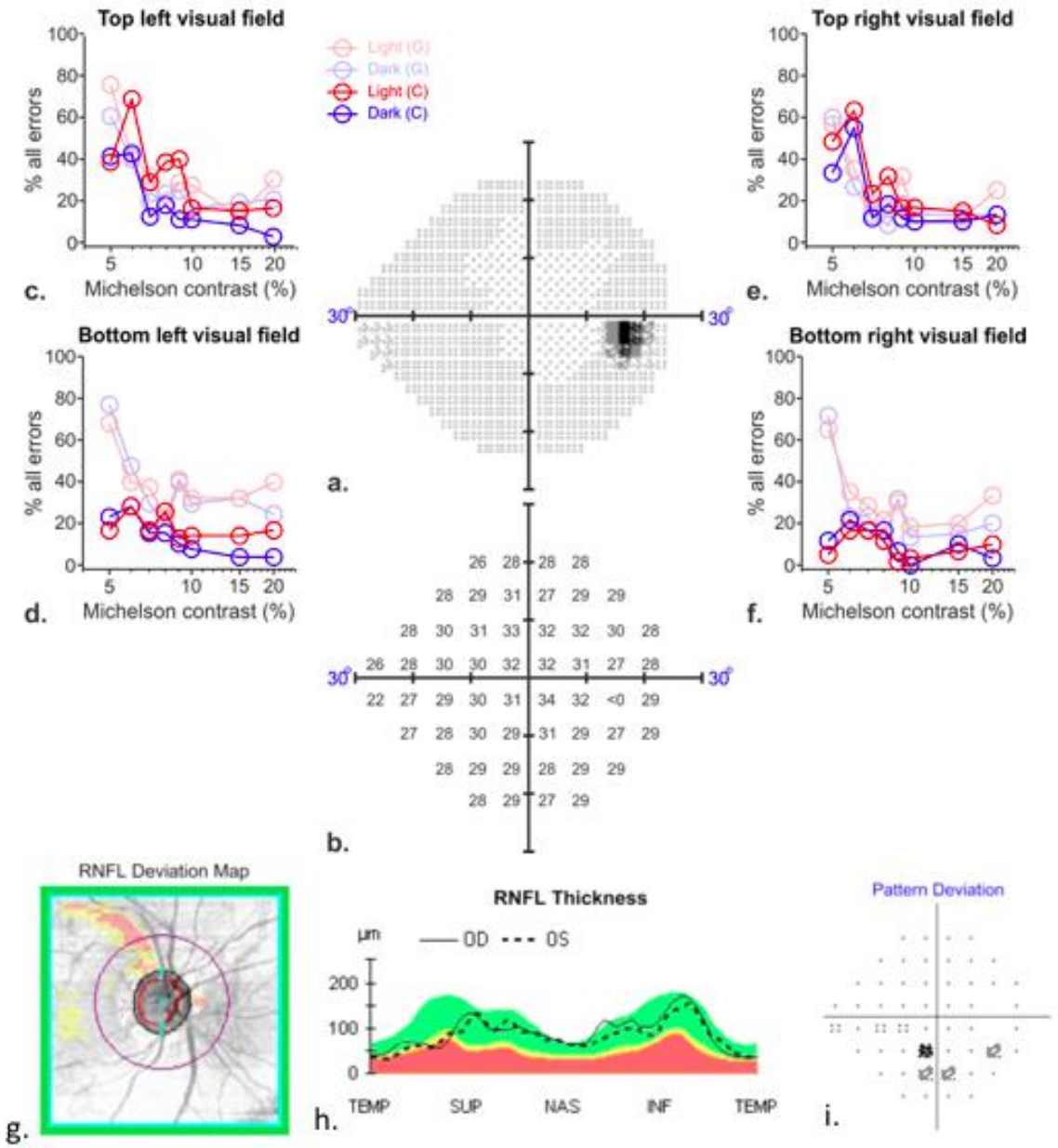

Figure 1. a. grey scale SAP, b. dB values of sensitivity SAP, c-f. % errors as a function of contrast for each of the 4 quadrants, corresponding g. RNFL deviation Map, h. TSNIT curve, i. Pattern deviation Plot

Superior Temporal		Inferior Temporal	
Control	Glaucoma	Control	Glaucoma
34	33	34	31
34	32	33	30
34	31	32	30
32	31	32	29
31	30	31	29
31	30	31	29
31	30	30	29
30	29	30	28
29	28	28	28
28	28	28	28
	P-value = .0027		P-value = .0047

Table 1. Analysis of 10 most sensitive points for the control (blue box) v. glaucoma patient (green box) shown in Figure 1.