Progression analysis for objective perimetry

WGCABS-498

ted.maddess@anu.edu.au

Ted Maddess[1], Corinne F Carle[1], Emilie MF Rohan[1], Ozge Sarac[2], Maria Kolic[3], Rohan Essex[1,3], Joshua P van Kleef[1]

[1]Neuroscience JCSMR ANU, [2]Wills Eye Hospital, [3]Ophthalmology Medical School ANU

INTRODUCTION

Purpose: To assess visual field progression analysis of the ObjectiveFIELD Analyser (OFA) (**Fig. 1**), using the ObjectiveFIELD Index (OFI).

Background: The 4th-generation P30 and P60 OFA stimuli[1] have stimuli designed to match retinal magnification (**Fig. 2**) but produce 30-2 style reports (**Fig. 3A**). They are safe in epilepsy and migraine.[2,3] In 40 persons with glaucoma (PwG) tested twice (160 reports) the test durations/eye for P30 and P60 (30-2) were 4.40±0.65 and 4.28±0.33 minutes respectively (mean±SD), while for HFA SITA Fast (24-2) in the same subjects on the same day the duration was 6.06±0.93 min. Diagnostic power was similar.

OFA test-retest variability has been reported to be good in PwD (**Fig. 3B,C**) suggesting good ability to track progression. All the OFA summary measures have progression analysis. Here we examine an index like the VFI, the OFI. *There are separate OFIs for sensitivity and delay (**Fig. 4**).*

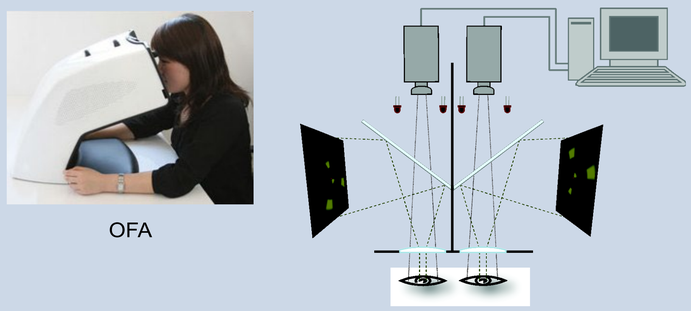

Figure 1. OFA objective perimetry device Sequences of briefly presented independent stimuli are shown concurrently on two LCD displays to both eyes. Infrared cameras image the pupils. The records of changing pupil diameter reflect brain activity generated by the stimuli.

METHODS

The OFI is a percentage score between normal (100%) and perimetrically blind (0%). We assessed the OFI for both a wide-field (P60) and macular (P30) OFA test whose stimulus arrays are scaled versions of each other, spanning the central 60 and 30 deg of the field (**Fig. 2**). Each test concurrently presented independent stimuli to 44 regions per eye, retesting each test location 90 times in 7 minutes.[1] P60 data were mapped to a 30-2 layout (**Fig. 3A**), P30 to a scaled version. Sensitivity and delay reports are made for each eye. Data was collected from 19 glaucoma patients over 5 years using a prototype of the OFA (Konan Medical USA). *Test-visits included pairs of P30 and P60 test sessions performed 2 weeks apart.* Those visits were repeated 7, 6, and 5 times in 7, 9, and 3 subjects respectively for P60, and for 8% fewer tests for P30.

HFA SITA-fast fields were obtained randomly on the 1st or 2nd session of a test-visit. OFI slopes were estimated using least-squares (Lsq) and robust regression (RR). Randomly selecting OFA tests from the 1st or 2nd session allowed the formation of cross-validation data sets with the same number of tests over time as the HFA data.

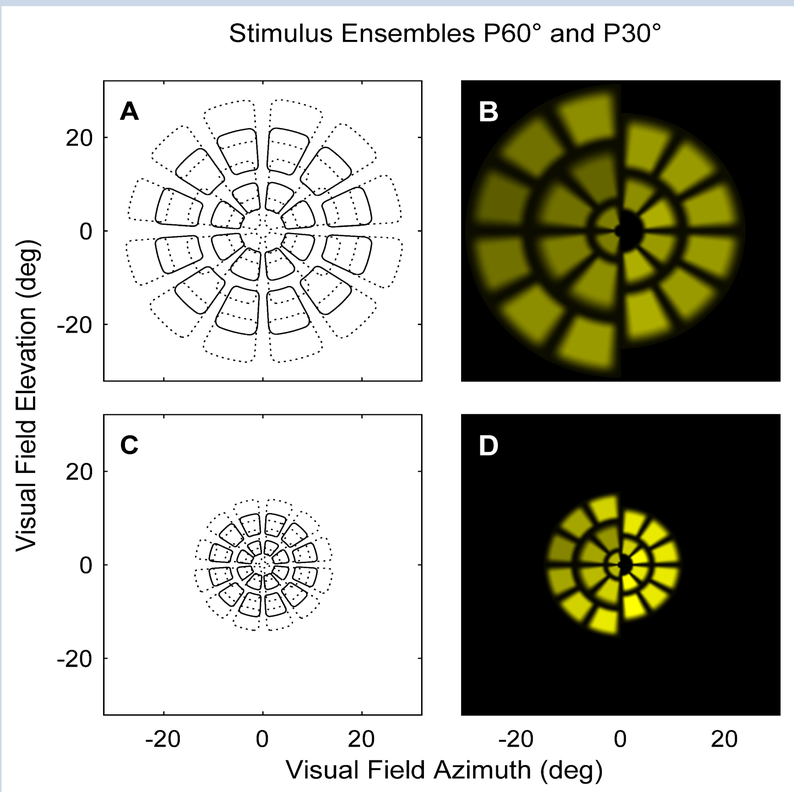

Figure 2. Multifocal stimulus arrays for the P60° and P30° stimulus protocols. The possible locations of the pseudo-randomly presented 44 test-stimuli/eye comprised five rings across: (**A**) the P60° array spanning ±30° from fixation; or (**C**) P30° array spanning ±15°. Although stimuli could potentially overlap in space (dashed lines), in practice they were presented so that this never happened. Both P30° and P60° consisted of 5 rings of lozenge-shaped stimuli. Going from central to outer the borders of the rings are dashed (rings 1,3,5) or solid (rings 2,4). (**B,D**) show half the left-eye stimuli to Illustrate the luminance-balancing method that adjusts response sizes from normal subjects to be more even across the examined field. The two halves show rings 1,3,5 on the left and 2,4 on the right. There are thus 11 stimuli per quadrant. The maximum luminance of the P30° and P60° stimuli were 288 and 150 cd/m^2 respectively. The backgrounds were 10 cd/m^2.

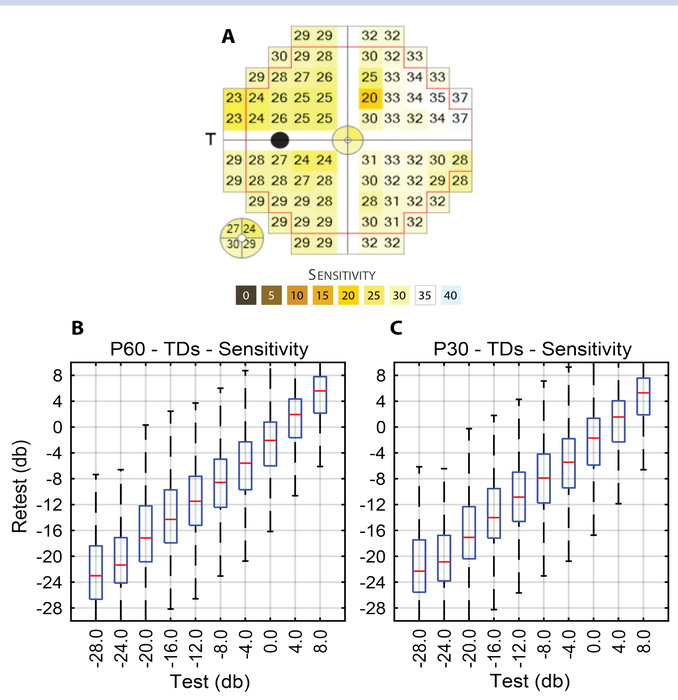

Figure 3. **A**) Example of the OFA's 30-2 style report for dB sensitivities. There are 4 extra stimuli centrally and these are reported numerically at bottom left. P30 has as similar report. **B,C**) Test-retest plots of total deviations (TDs) based upon the two test sessions 2-weeks apart. The boxes are inter-quartile ranges (iqr), and the whiskers are the inter-decile ranges. At the damaged end the iqrs are about half the size of those reported in the literature for standard automated perimetry.

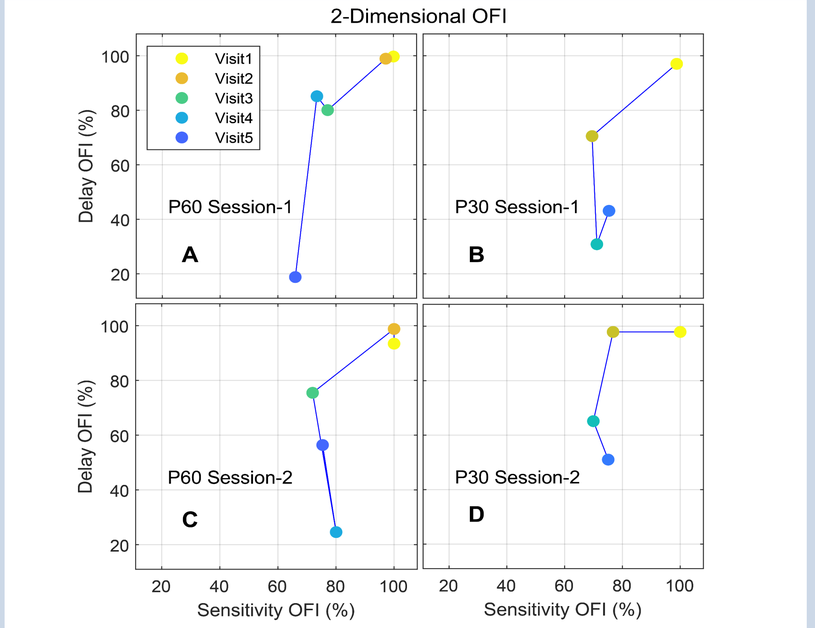

Figure 4. Illustration of the development of the sensitivity and delay versions of the OFI in an eye of a PwG over 5 visits in 5 years. For this eye, the delay OFI changes proportionately more. The 2 sessions/test are the tests 2 weeks apart.

RESULTS

The interquartile ranges of test-retest variability of PwG sensitivities were better than reported values for Standard Automated Perimetry (**Fig. 3B,C**).

For HFA, 8/38 eyes showed significant VFI progression ($p \leq 0.05$). For P60 sensitivities, and comparing Lsq:RR, 10:11/38 tests showed significant progression on some validation cycles, 7:9/38 for P30. OFA delays showed fewer progressing fields, for P60 3:2/38 and P30 3:5/38. About half of eyes identified by delay changes differed from those identified by sensitivity changes. For OFA fields not showing progression when HFA did, the mean HFA p-value was 5%. Of P60 fields matching HFA progression the mean HFA p-values were < 2.6%. For Lsq the inter-decile range of OFA sensitivity slopes was: P60 -0.65 to -8.36 %/y and P30 -0.33 to -2.84 %/y; for delays: P60 -0.14 to -1.18 %/y and P30 -0.17 to -12.1 %/y.

Plots of delay on sensitivity OFI data show they can evolve at different rates over 5 years (**Fig. 4**). Reproducibility across sessions & tests was good.

CONCLUSIONS

Sensitivity and delay OFI data progressed significantly, sometimes independently, suggesting independent disease processes. Significant OFI slopes < -0.5 %/year occurred, indicating modest progression can be tracked. When HFA p-values were small there was better agreement with OFA.

For <90 second OFA see WGCAB-539.

REFERENCES

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3. Ali EN, Lueck CJ, Martin K, Borbelj A, Maddess T. (2022) Response characteristics of objective perimetry in persons living with epilepsy. . J Neurol Sci. 436(120237):1-5.