Full correction of refractive errors during automated perimetry: does it really matter?

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Abstract

Aims: To study the effects of full correction of refractive errors on the reliability indices during automated perimetry.
Methods: In this retrospective study, records of all patients who underwent automated perimetry during June to July 2008 were reviewed. We compared the records of the patients who underwent automated perimetry without any refractive error correction or only partial correction of refractive errors (Group 1) with those having full correction of refractive errors (Group 2) during visual field testing. We analyzed whether full correction of the refractive errors during visual field testing improved the reliability indices (false-positive errors, false-negative errors, and fixation losses) of the visual fields.
Results: There was improvement in reliability indices after full correction of refractive errors, but the difference was not statistically significant ($p = 0.3$). Males showed better reliability than females ($p = 0.07$). Subjects aged 60 years or younger had more reliable fields ($p = 0.02$).
Conclusions: Imposing full refractive error correction as opposed to partial refractive error correction did not significantly alter the reliability of visual fields during automated perimetry.

Key words: *Refractive errors; Visual field tests; Visual fields*

Introduction

Automated perimetry has become an integral part of ophthalmic practice for diseases particularly glaucoma and neuro-ophthalmic diseases. Reliable visual fields (VFs) are important for accurate determination of disease progression. Several factors affect the visibility of the test object and patient's response during VF examination — particularly refractive error (RFE), stimulus size and intensity, contrast between object and background, and attentiveness of the patient.[1] When testing within the central 30° of the VF, it is standard practice to fully correct patients' RFE and add presbyopia correction when needed.[1,2]

RFE results in the formation of a blurred image on the retina causing a generalized reduction in sensitivity, especially in the central field. Defects caused by incorrect refraction can mimic isolated scotomas.[3-5] Each diopter of uncorrected refraction causes a 1.26 dB depression of retinal sensitivity.[4]

We evaluated whether implementation of full correction of RFE during automated perimetry had any effect on reliability indices (RIs), i.e. false-positive (FP) and false-negative (FN) responses and fixation losses (FLs).

Methods

This retrospective study was performed at the ophthalmic clinic of Prince of Wales Hospital, Hong Kong. We reviewed patient records during two periods — from June 15 to June 23, 2008 (before implementing full correction of RFE) [Group 1] and July 23 to July 31, 2008 (after implementing full correction of RFE) [Group 2].

In Group 1, refraction was not assessed prior to VF testing. Those patients wearing spectacles had the spectacle power checked with an automated focimeter and correcting lenses were used accordingly during VF testing. In patients who did not wear spectacles, no correcting lenses were used. Presbyopic add was given to all eligible patients according to the recommended guidelines as stated in the Humphrey Field Analyzer instruction manual.[2]

From July 1, 2008, full RFE correction was implemented during VF testing, and constituted Group 2. In this group, refraction was assessed prior to VF testing and full correction of RFE (spherical correction within 0.5 diopters [D] and a cylinder correction within 0.25 D) was implemented according to Humphrey guidelines.

All the patients underwent VF testing by automated perimetry (Humphrey Field Analyzer 750 II, Carl Zeiss Meditec, Dublin [CA], USA). We assessed RI (FP, FN, FL) in both groups.

All patients underwent central 24-2 SITA (Swedish Interactive Thresholding Algorithm) standard (STD) or central 30-2 SITA STD testing. The background luminance was 31.5 apostilbs and size III white stimulus was presented at a distance of 30 cm. We used visual acuity (VA) of 20/200 as the cut-off point. Those subjects with a VA worse than 20/200, persons younger than 12 years and those who underwent 10-2 VF test were excluded. We modified the recommended guidelines to interpret the RIs (**Table 1**[6]).

We set our reliability criteria for FP responses at or less than 10%, FN responses to less than 30% and FL to less than 20%. Statistical analysis was performed using the Statistical Package for the Social Sciences (Windows version 13; SPSS Inc, Chicago [IL], USA); the Pearson Chi-square test was used for data analysis. A p value of less than 0.05 was considered statistically significant.

Results

In Group 1, 93 subjects fulfilled the criteria (age range, 19 to 88 years; mean age, 63 years). In Group 2, 101 patients (independent of subjects in Group 1) fulfilled the criteria (age range, 18 to 87 years; mean age, 60 years). The demographic characteristics of patients in Groups 1 and 2 are shown in **Table 2**. In Group 1, 180 eyes of 93 patients underwent VF testing, of which 58% of the VF reports were reliable with the partial correction of RFE. In Group 2, 194 eyes of 101 patients underwent VF testing with full correction of RFE of which 63% of the VF reports were reliable (**Figure**).

All the patients in both groups were ethnic Chinese and came from the same population. In both groups, the number of 24-2 field tests and 30-2 field tests were comparable. In Group 1, 81% of the patients underwent 24-2 testing and 19% underwent 30-2 test. In Group 2, 79% of the patients underwent 24-2 test and 21% underwent central 30-2 test.

Table 3 shows the RI of VFs in Groups 1 and 2. Patients with full RFE correction showed better reliability; though the difference was not statistically significant (p = 0.3), it appeared clinically significant for providing high-quality patient care. There were other interesting inferences, namely the males showed better reliability than females (p = 0.07) [**Table 4**] as did patients aged 60 years or less (p = 0.02) [**Table 5**].

We also studied the correlation between VA (<0.5) and RI and found no statistically significant association between poor VA and low VF reliability (p = 0.1).

Table 1. Reliability indices for automated perimetry.

Reliability index	Recommended[6*] (%)		Modified[†] (%)	
	Reliable	Unreliable	Reliable	Unreliable
False positive	≤ 33	> 33	≤ 10	> 11
False negative	≤ 33	> 33	< 30	≥ 30
Fixation losses	≤ 20	> 20	< 20	≥ 20

[*] Recommended[6] = Recommended guidelines (Reference 6).
[†] Modified = Authors' modification to interpret the reliability indices.

Table 2. Demographic characteristics of patients who underwent visual field testing.

Demographic characteristics	No. (%) of patients	
	Group 1 (n = 93)	Group 2 (n = 101)
Gender		
Male	44 (47.3)	43 (42.6)
Female	49 (52.7)	58 (57.4)
Age (years)		
≤ 60	36 (38.7)	56 (55.4)
> 60	57 (61.3)	45 (44.6)

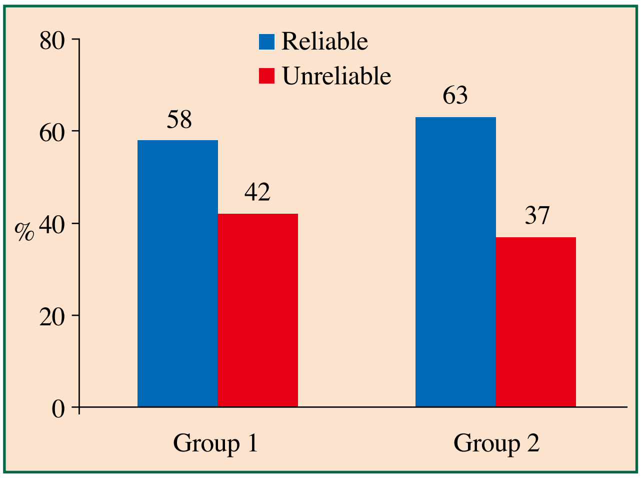

Figure. Reliability of visual field testing before and after implementing full correction of refractive errors.

Table 3. Comparison of visual field reliability in two groups.				
	No. (%) of eyes			p Value*
	Group 1 (n = 180)	Group 2 (n = 194)	Total	
Reliable	104 (57.8)	122 (62.9)	226 (60.4)	0.3
Unreliable	76 (42.2)	72 (37.1)	148 (39.6)	

* Chi-square test.

Table 4. Comparison of visual field reliability in relation to gender.				
Gender	No. (%) of patients			p Value
	Reliable	Unreliable	Total	
Male	73 (83.9)	14 (16.1)	87	0.07
Female	77 (72.0)	30 (28.0)	107	

Table 5. Comparison of visual field reliability in relation to age.				
Age (years)	No. (%) of patients			p Value
	Reliable	Unreliable	Total	
≤ 60	81 (88.0)	11 (12.0)	92	0.02
> 60	69 (67.6)	33 (32.4)	102	

On studying the association between the automated perimetry test type (i.e. the 24-2 SITA program and 30-2 SITA program), there was no statistically significant association between any one type of VF test pattern and the RI ($p = 0.3$).

Discussion

Subject reliability is important for any psychophysical test because reliable subjects are more likely to yield accurate VFs. In considering the RI, high FP rates can indicate poor reliability.[7] However, interpretation of high FN rates is more complicated and can indicate poor reliability or be associated with scotoma and unstable fixation.[7] Some studies showed that the actual FP response rate in patients is much higher than the set criterion of FP responses.[7,8] Therefore we set our reliability criteria for FP responses at or less than 10%. On the other hand, to be reliable, higher FN responses could be suggestive of glaucomatous defects, for which reason we set our reliability criteria as less than 30% of FN responses.

The sample sizes (numbers in each subgroup) were small, which rendered it hard to obtain significant results. Moreover, the patients did not have any prior perimetric experience. Since this was a retrospective study, we included consecutive patients and therefore did not exclude those with retinopathy and cataract who had undergone two different test strategies — central 24-2 SITA STD and central 30-2 SITA STD.

Weinreb and Perlman[9] and Heuer et al[10] had determined the effect of RFEs on threshold retinal sensitivity during automated perimetry. To our knowledge, no such study has been performed to detect the effect of partial or full RFE correction on RIs of VF during automated perimetry.

We conclude that imposing full refractive as opposed to partial RFE correction did not alter the reliability of VF assessment by automated perimetry.

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