



Agreement amongst consultant ophthalmologists on levels of visual disability required for eligibility for certificate of sight impairment

Sight impairment registration using binocular composite visual fields

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Abstract

Background Registration as sight impaired allows access to services important for patients. The rates of sight impairment due to visual field loss are underestimated. Previous work has shown that evaluation of visual field defects in both eyes produces poor agreement among ophthalmologists for categorisation of patients as eligible for sight impairment registration.

Aim To evaluate the impact of binocular summation of both eye glaucomatous visual field defects on agreement for sight impairment registration.

Methods Thirty consultant ophthalmologists (Graders), graded 50 glaucomatous visual field sets. Each consisted of both monocular fields and summated binocular plots. Graders classified the visual field sets as sight impaired (SI), severely sight impaired (SSI) or neither. Trichotomous, (SI, SSI or no sight impairment) and dichotomous (any sight impairment versus no sight impairment) concordance values were estimated for the group of graders as a whole and for glaucoma and non-glaucoma experts.

Results For trichotomous analysis the overall kappa agreement rate was 0.29; for dichotomous analysis it was 0.40. There was no material difference between glaucoma experts and non-experts.

Conclusion Overall agreement was modest. Grading for SI showed the poorest levels of agreement. Using binocular fields does not appear to improve concordance for sight impairment registration. Moreover, there is no difference in agreement between glaucoma and non-glaucoma experts. An overall score for visual disability using mean deviation may be a more pragmatic approach.

Background

Registration as visually impaired allows access to financial benefits and support services to facilitate employment and maintain independence [1]. In the United Kingdom (UK), this requires a consultant ophthalmologist to complete a form indicating whether a patient is eligible to be registered as either sight impaired (SI) or severely sight impaired (SSI). The criteria for registration are determined by the level of visual acuity and extent of visual field loss and defined nationally [1]. The

guidance can be found at the following url: <https://www.gov.uk/government/publications/guidance-published-on-registering-a-vision-impairment-as-a-disability>.

Glaucoma is the second most common cause for sight impairment or severe sight impairment among adults in England and Wales [2]. Glaucoma sight loss is often related to severe visual field loss rather than visual acuity loss and there is a clear relationship between loss of quality of life and glaucoma field loss [3].

Rates for visual impairment registration are underestimated [4–6]. This is more likely if patients have visual field loss rather than visual acuity loss as their criteria for eligibility and so affects patients with glaucoma disproportionately [4, 7].

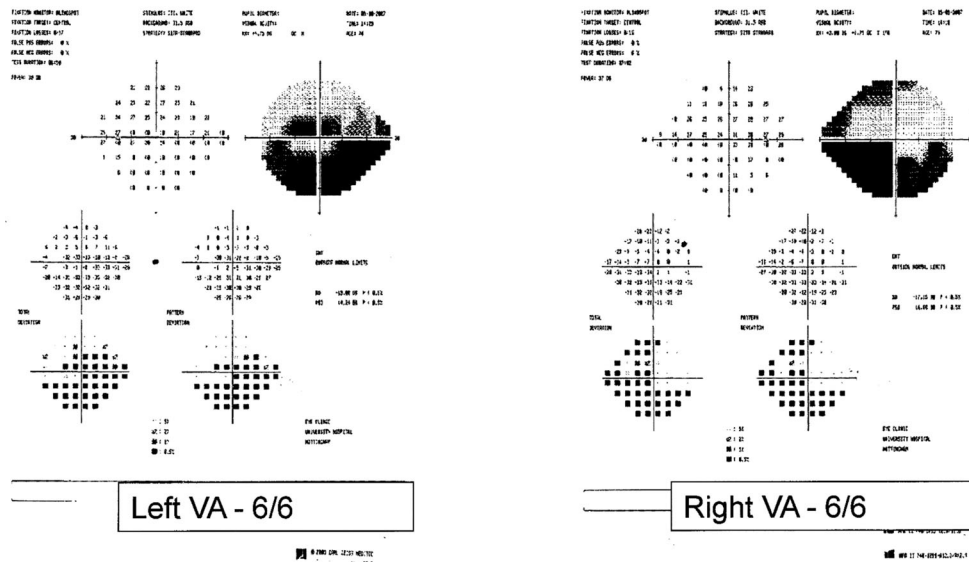
A previous study has shown that agreement amongst consultant ophthalmologists is poor when using monocular visual field print outs to determine whether glaucoma-related field loss achieves the criteria for registration [8]. One explanation for this is that registration requires significant field loss in each eye and this may be a difficult judgement when assessing the

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Case 31 – Monocular Fields



Case 31 – Binocular Fields

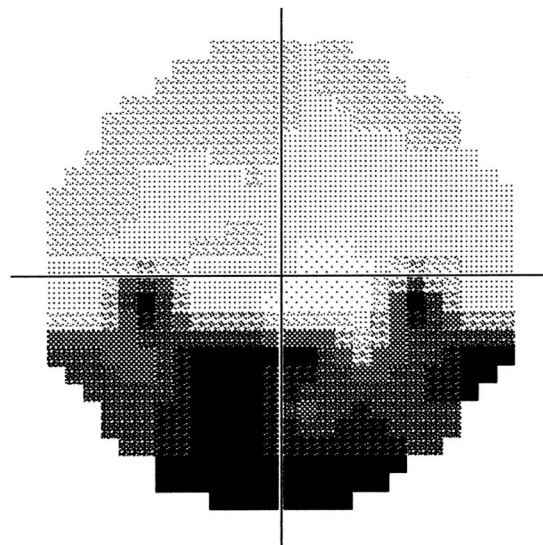
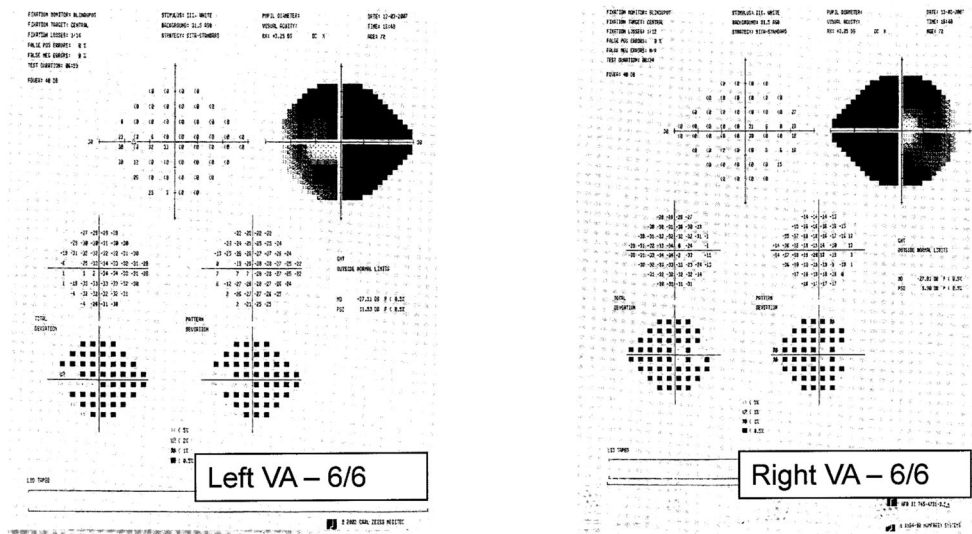


Fig. 1 Example of monocular and related merged binocular visual fields. This figure shows right and left monocular visual fields with significant visual field loss in both eyes and the subsequent merged binocular visual field composite. This example had low grader agreement.

fields as unocular information as is current practise (Fig. 1). One solution to overcome this may be to present the visual field information as a binocular composite of the merged individual right and left eye monocular visual fields to facilitate judgement on the extent of binocular visual field loss present (Fig. 1).

The aim of this study was to investigate if agreement between clinicians for registering patients as SI or SSI could be improved by using a binocular composite of the patients’ visual field, rather than the traditional monocular presentation.

Case 7 – Monocular Fields



Case 7 – Binocular Fields

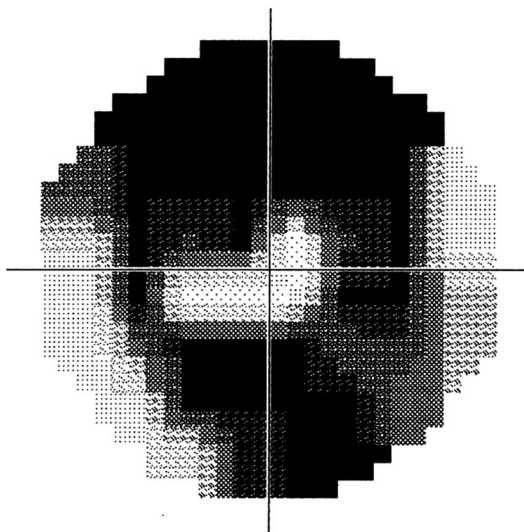


Fig. 2 Example of monocular and related merged binocular visual fields. This figure shows right and left monocular visual fields with advanced visual field loss in both eyes and the subsequent merged binocular visual field composite. This example had high grader agreement.

Methods

Thirty consultant ophthalmologists (18 non-glaucoma consultants and 12 glaucoma consultants) from four centres were invited to participate. One grader was excluded as the

task was incomplete. The methodology and analysis was identical to the earlier work by Guerin et al. [8] with the addition of a binocular composite visual field. Each grader was provided with a folder containing fifty anonymised pairs of visual fields. The visual field pairs were chosen at

Table 1 Total number of field pairs assessed and their grading into sight impairment categories. Data are presented for the overall group of consultants and then for the subgroups of glaucoma and non-glaucoma specialists.

Rater	No. field pairs	Registration category assigned (%)		
		Severely sight impaired	Sight impaired	Neither
Overall	1450	246 (17.0%)	611 (42.1%)	593 (40.9%)
Glaucoma	600	120 (20.0%)	253 (42.2%)	227 (37.8%)
Non-glaucoma	850	126 (14.8%)	358 (42.1%)	366 (43.1%)

random from a database of patients with bilateral glaucomatous visual field loss and binocular Snellen visual acuity of at least 6/12, in order to isolate the visual field as the criteria for certification.

The criterion for blindness registration was printed for reference at the front of this folder and guidance for registration were provided. Each case consisted of a visual field set including the monocular right and left eye Humphrey 24-2 SITA standard visual field outputs and the combined binocular composite for the same pair of visual fields. The composite was generated through Progressor software which allows merging of right and left visual fields into a grey scale composite representing the binocular visual field [9]. The pairs were numbered so that each grader completed the visual field assessment in the same order. Graders were asked to assess whether the patient qualified for registration as SI, SSI or neither based on their visual field loss. There was no time-limit for completion of the task.

To explore the variation in responses to the different visual fields we undertook further analysis comparing the consensus response (most frequent response per visual field) against the non-consensus response and expressed this as a percentage.

Examples of the visual field task given to graders are shown in Figs. 1 and 2.

Statistical analysis

The inter-rater agreement was calculated using Fleiss' generalised kappa [10], Krippendorff's alpha [11, 12] and the interclass consistency (ICC) scores [13, 14]. Such scores are univariate statistics suitable for designs involving multiple graders that allow estimation of the size of disagreement [15, 16]. Fleiss' Kappa ranges from -1 to $+1$, with negative values suggesting agreement less than that which would have occurred by chance. Values of $0-0.2$ suggest poor agreement, $0.2-0.4$ fair agreement. Values of $0.6-0.8$ suggest good agreement and $0.8-1$ suggest very good agreement [17]. Krippendorff's alpha can be interpreted as showing significance when >0.8 and allowing for tentative conclusions of agreement to be drawn when >0.67 and <0.8 [18, 19].

Results

The mean deviation (MD) of visual fields in the dataset was -20.46 dB for the right eye (median -21.68 and SD 7.25) and -18.94 dB for the left eye (median -18.56 and SD 7.53).

Overall, 42.1% (611) of field pairs were graded as SI, 17.0% (246) as SSI and the remaining 40.9% (593) as neither (Table 1). Glaucoma specialists were more likely to classify fields in the SSI category than non-specialists (Chi squared test for trend $p = 0.006$).

There was significant variation in the grading of each visual field pair from no sight impairment through to severe sight impairment (Table 2). The mean levels of disagreement were calculated by comparing to the consensus view for each case. The mean level of disagreement was 33.4% (median: 35.7%) with a range of $0-52\%$. When comparing against the consensus using no sight impairment or any sight impairment we found that levels of disagreement improve slightly to a mean of 22.3% (median: 23.8%) with a range of $0-47.6\%$.

Overall inter-rater agreement scores for the three categories (no sight impairment, sight impairment or severe sight impairment) were fair (Table 3). This trichotomous analysis showed an overall Kappa value of 0.29 (95% CI: 0.28–0.30). No difference was recorded between glaucoma and non-glaucoma specialists.

Table 4 shows slightly improved agreement when comparing in a dichotomous manner, i.e. no sight impairment versus any sight impairment. Overall, agreement was fair with the Kappa value being 0.4 (95% CI: 0.38–0.41). There was better agreement when compared with trichotomous analysis. There was no significant difference between glaucoma and non-glaucoma consultants.

Discussion

The most recent figures available from 2012 to 13 indicate glaucoma remains the second most common cause for severe sight impairment in England and Wales. In this period, 11% of SSI and 7.6% of SI registrations were due to glaucoma, representing 1818 newly registered people. It is known that there is under-registration of those eligible for

Table 2 Disagreement from consensus response, (most frequent response), for each case.

Case	Disagreement from consensus, trichotomous %	Disagreement from consensus, dichotomous %
1	40.48	7.14
2	38.10	35.71
3	45.24	23.81
4	50.00	50.00
5	35.71	2.38
6	35.71	2.38
7	28.57	0.00
8	40.48	4.76
9	42.86	2.38
10	50.00	28.57
11	26.19	26.19
12	50.00	50.00
13	30.95	30.95
14	28.57	28.57
15	28.57	4.76
16	35.71	35.71
17	42.86	40.48
18	23.81	23.81
19	45.24	40.48
20	4.76	4.76
21	28.57	7.14
22	52.38	47.62
23	38.10	14.29
24	40.48	38.10
25	45.24	45.24
26	0.00	0.00
27	14.29	0.00
28	4.76	4.76
29	21.43	21.43
30	52.38	33.33
31	54.76	40.48
32	23.81	23.81
33	42.86	42.86
34	4.76	4.76
35	50.00	42.86
36	50.00	47.62
37	50.00	50.00
38	2.38	2.38
39	21.43	0.00
40	11.90	11.90
41	33.33	19.05
42	28.57	7.14
43	42.86	2.38
44	23.81	4.76
45	4.76	4.76

Table 2 (continued)

Case	Disagreement from consensus, trichotomous %	Disagreement from consensus, dichotomous %
46	42.86	42.86
47	52.38	47.62
48	52.38	38.10
49	23.81	23.81
50	33.33	4.76
Mean	33.43	22.33
Median	35.71	23.81
Range	0–52	0–47.6

Presented as deviation from consensus for trichotomous (SI vs. SSI vs. no sight impairment) categories and dichotomous categories (any sight impairment vs. no sight impairment).

SSI/SI registration [4, 5]. Robinson et al. found more than half of glaucoma patients eligible were not registered and King et al. noted that those eligible for registration through visual field criteria were significantly less likely to be registered than those through visual acuity criteria. In addition, both noted that those with on-going treatment were less likely to be registered. Therefore, those suffering from glaucoma are at a disadvantage in being identified for sight impairment registration and the benefits which these carries.

Currently patients may be offered registration depending not only on the level of visual deficit they suffer but also on the consultant ophthalmologist that is registering them. Terminology within the explanatory document for registration is also unclear. Terms such as ‘moderate contraction’ or ‘marked contraction’ are open to interpretation and this may contribute to the relatively poor level of agreement between consultants. To measure this, Guerin et al. undertook an evaluation of agreement amongst UK consultant ophthalmologists of their categorisation of monocular visual field pairs as eligible for SI, SSI or neither. They found a disappointingly poor level of concordance [8]. In this study we tested the hypothesis that merging the visual fields into a single binocular visual field composite would make the extent of functional visual field loss clearer and interpretation of visual field loss easier resulting in better agreement amongst consultants for registration purposes. However, it was found that composite binocular visual fields supplementing monocular visual fields also has low levels of agreement and is not materially different from the agreement levels noted by Guerin for monocular visual fields alone. Furthermore, this is the case for glaucoma and non-glaucoma consultant ophthalmologists indicating that agreement does not improve with specialist experience and that the current method of assessment is fundamentally flawed.

Table 3 Trichotomous analysis of inter-rater agreement scores for the three categories of not sight impaired, sight impaired or severely sight impaired.

Rater	Kappa (95% CI)	Alpha (95% CI)	ICC (95% CI)
Overall	0.29 (0.28–0.30)	0.29 (0.20–0.37)	0.52 (0.41–0.63)
Glaucoma	0.29 (0.26–0.31)	0.29 (0.20–0.37)	0.49 (0.36–0.62)
Non-glaucoma	0.28 (0.26–0.30)	0.28 (0.20–0.36)	0.53 (0.42–0.65)

Data are presented for the overall group of consultants and then for the subgroups of glaucoma and non-glaucoma specialists.

Kappa Fleiss' generalised kappa, *Alpha* Krippendorff's alpha, *ICC* intraclass consistency score, *CI* confidence interval.

Table 4 Dichotomous analysis of inter-rater agreement scores for the two categories of not sight impaired or any sight impairment (SI or SSI).

Rater	Kappa (95% CI)	Alpha (95% CI)	ICC (95% CI)
Overall	0.40 (0.38–0.41)	0.40 (0.28–0.51)	0.40 (0.31–0.52)
Glaucoma	0.38 (0.34–0.41)	0.38 (0.25–0.50)	0.39 (0.28–0.52)
Non-glaucoma	0.37 (0.35–0.40)	0.37 (0.26–0.48)	0.42 (0.31–0.54)

Data are presented for the overall group of consultants and then for the subgroups of glaucoma and non-glaucoma specialists.

Kappa Fleiss' generalised kappa, *Alpha* Krippendorff's alpha, *ICC* intraclass consistency score, *CI* confidence interval.

In the United States the Social Security Administration has included the following visual field criterion to identify those eligible for blindness registration—an MD of -22 dB or greater in the better eye, determined by automated static threshold perimetry that measures the central 30° of the visual field [20]. If we were to apply this criterion to our dataset 13 of 50 (26.0%) patients would be eligible for SSI registration (as opposed to 17% categorised as SSI in this study). Furthermore, three of the authors, (RES, AJK and IJ) individually scored the visual field sets using this criterion and scored 13/50 visual fields as eligible for sight impairment registration with 100% agreement. This suggests using a quantitative criterion for evaluation of eligibility may greatly improve agreement. Furthermore, a global score using a combination of two monocular visual fields in patients' with glaucoma correlates well with patient's assessment of their vision [21] and quality of life [22]. An important difference, however, is that the USA have one category for sight impairment, whereas in the UK there are two.

Registration provides important support for poorly sighted individuals informing them of available support services and financial support and helping them to maintain an independent existence. However, access to this support is based on a consultant ophthalmologist recognising their eligibility and completing the registration documentation. This is more of an issue for those with severe visual loss related to visual field loss rather than visual acuity loss.

There is a need to standardise registration for SI and SSI. Terminology within the explanatory document for registration is unclear. Subjective terms such as 'moderate

contraction' or 'marked contraction' are open to interpretation. This may lead to high levels of disagreement as suggested by Guerin and this current study. Subsequently there will be inequity in access to help and benefits for those suffering similar levels of visual deficit. Moreover, it contributes to potential inaccuracy of levels of impairment recorded [23].

The observation by King and Robinson that patients with severe visual acuity loss are more likely to be registered than those with severe visual field loss suggests that provision of a more quantitative set of criterion may be helpful in improving agreement and reproducibility.

This is challenging in the context of visual field defects as many patterns of loss exist with differing degrees of impact on visual function and related quality of life measures. However, there is precedent for using an easily reproducible quantitative measurements to define eligibility for registration on the basis of visual field loss. Using a standard cut-off, for example a better eye MD of -22 dB, needs to be explored as a qualifying criterion for registration either alongside or instead of the current subjective and poorly reproduced criteria.

Conclusion

In conclusion, the use of composite merged visual fields does not materially improve agreement amongst consultant ophthalmologists when assessing patients for eligibility for SI or SSI registration. Rather than relying upon patterns of visual field loss it may be helpful to suggest a quantitative level of mean defect visual field loss beyond which all

patients should be considered eligible for sight impairment eligibility

Summary

What was known before

- Registration as sight impaired allows access to services important for patients. The rates of sight impairment due to visual field loss are underestimated. Evaluation of monocular visual field defects produces poor agreement among ophthalmologists for categorisation of patients as eligible for sight impairment registration.

What this study adds

- Using binocular fields does not appear to improve concordance for sight impairment registration. Moreover, there is no difference in agreement between glaucoma and non-glaucoma experts. An overall score for visual disability using mean deviation may be a more pragmatic approach.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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