

SCIENTIFIC CORRESPONDENCE

Quantifying relative afferent pupillary defects using a Sbisa bar

A McCormick, R Bhola, L Brown, D Squirrel, J Giles, I Pepper

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Aim: To compare the Sbisa bar (Bagolini filter bar) with neutral density filters (NDF) in quantifying relative afferent pupillary defects (RAPD).

Methods: 11 patients with a RAPD were graded and a neutral density filter bar was used to quantify the RAPD. This was repeated using the Sbisa bar. The Sbisa bar (Bagolini filter bar) is used by orthoptists to quantify density of suppression in amblyopia and is of a similar construct to NDFs. Before this clinical part of the study the luminance for each filter was measured, which enabled a direct comparison to be made.

Results: In the analysis of patients with RAPD a high correlation was found when comparing the Sbisa and NDF bars $r = 0.95$. This was statistically significant ($p < 0.001$). Correlation was also high when the luminance values for the filters were substituted for the clinical readings ($r = 0.92$; $p < 0.001$).

Conclusion: The Sbisa bar is a comparable instrument to the NDF bar in measuring RAPD. Its availability in the clinical situation makes it a practical choice.

The swinging flashlight test to detect a relative afferent pupillary defect (RAPD) is an established way of assessing retinal and optic nerve function.¹ Subjective grading leads to discrepancies between clinicians, is difficult to quantify, and limits its use in diagnosis. By accurately quantifying the defect additional information can be provided, which may aid management—for example, assessing retinal ischaemia following central retinal vein occlusion.²

Thompson *et al* describe a method of quantification using neutral density filters.³ The swinging flashlight test is performed with increasing density of filter before the healthy eye until the sign disappears or is reversed. Neutral density filters (NDF) are available in the form of a rack or bar containing 10 filters of increasing density (Fig 1, top). The density of the filters is measured in log units ranging from 0.3 to 3.0 in steps of 0.3.

Orthoptists use a similar instrument, the Sbisa or Bagolini filter bar, to assess density of suppression in strabismus. It consists of 17 sequential red filters (Fig 1, bottom). As Sbisa bars are generally much easier to obtain than NDFs in most departments, the authors set out to assess their use, in the same way as the NDF, to neutralise and therefore quantify a relative afferent pupillary defect.

METHOD

The arbitrary scale on the Sbisa bar (1–17) and the apparent non-linear increase in density of filter prompted further investigation. No technical information was available from the manufacturers of the Sbisa bar or their distributors. The photometric brightness (luminance cd/m^2) of the filters for both bars was measured in a laboratory using an IL 1700 photometer, collimator, and detector. An indirect ophthalmoscope



Figure 1 Top: neutral density filter bar, bottom: Sbisa bar (Bagolini filter bar).

was used as the light source: spot size (large), voltage (6 V), bulb type, and distance from the cornea (30 cm) were all standardised. The 6 V setting was used to enable accurate assessment of subtle RAPD as demonstrated by Browning *et al*.⁴ This was directed at the photometer. Both were fixed to stands. In a darkened room a zero reading was taken followed by each filter before the photometer for each bar. The distance from the photometer to the filter was 2–3 cm approximating the test *in vivo*. Three readings for each were made.

Patients were selected from the eye casualty clinic over a period of 2 months. There were two entry criteria: the presence of a RAPD and a normal pupil. Two patients were excluded because of iris pathology. Two clinicians carried out all the swinging flashlight examinations. The patient fixed on a 6/60 Snellen letter at 6 metres in a darkened room. An indirect ophthalmoscope head set was used as the light source and standardised as for the luminance measurements.

The RAPD was graded by both clinicians according to the I-V system of Bell *et al* in order to detect interexaminer variation. A swinging flashlight test was carried out with each pupil illuminated for 3 seconds; grade I, initial weak constriction with greater redilatation; grade II, initial stall and greater redilatation; grade III, immediate pupillary dilatation; grade IV, immediate pupillary dilatation following 6 seconds of illumination; grade V, immediate pupillary dilatation with no secondary constriction at all.⁵

Table 1 Patient data

NDF	Sbisa	Examiner 1	Examiner 2	Pathology	Sex	L or R
0.6	2	I	I	CRVO	M	L
0.6	3	I	I	AION	M	L
0.9	4	I	I	CRAO	F	R
0.9	7	I	I	AION	F	R
0.9	7	II	III	POHS	F	L
1.8	12	III	III	AION	F	R
1.8	14	IV	IV	ON	F	L
2.7	15	IV	V	TRD	M	L
3	16	IV	V	OA	M	L
3	16	IV	IV	AION	F	R
3	17	V	V	CRVO	F	L

CRVO = central retinal vein occlusion; AION = anterior ischaemic optic neuropathy; CRAO = central retinal artery occlusion; POHS = presumed ocular histoplasmosis syndrome; ON = optic neuritis; TRD = total retinal detachment; OA = optic atrophy.

One examiner then graded the RAPD with the NDF bar while the other examiner used the Sbisa bar using the method described by Thompson *et al.*³ The allocation of bar and order in which the test done was random. Each was blind to the result of the other. Between tests the patient was rested for 3 minutes to enable dark adaptation allowing a standard starting point. While Sbisa bar filters are red and NDF neutral, it is the apparent brightness not colour that determines pupil response; however, the adaptation of the retina to light can influence pupillary reactions.⁶ A filter before one eye can cause asymmetric retinal bleaching. To reduce this, after 4–5 “swings” the filter was removed and both pupils illuminated with the light source.

Quantifying RAPD by this method depends upon clearly identifying an end point. The examiners had to agree on this by first familiarising themselves with the technique in several trial patients before the start of the investigation. The end point can be taken as either the elimination of the sign (brisk constriction with the same redilatation in both eyes) or reversal (looking at the eye with the RAPD-brisk constriction by direct illumination and dilatation by indirect illumination). We used the latter as it was practical to examine only the uncovered eye in a darkened room. This may overestimate the grade of RAPD but, as this is consistent, it should not influence the conclusion that the two tests are comparable.

RESULTS

Eleven patients met the selection criteria. There were four men and seven women, four right eyes and seven left. Pathologies were varied (Table 1). Interobserver variability was low

Table 2 Photometric data

Sbisa bar filter number	Log of luminance	NDF bar filter number	Log of luminance
1	5.66	0.3	6.00
2	5.58	0.6	5.69
3	5.59	0.9	5.40
4	5.39	1.2	5.10
5	5.29	1.5	4.85
6	5.24	1.8	4.55
7	5.17	2.1	4.27
8	5.17	2.4	3.97
9	5.08	2.7	3.67
10	5.00	3.0	3.35
11	5.00		
12	4.97		
13	4.64		
14	4.47		
15	3.83		
16	2.24		
17	2.17		

following analysis of Bell *et al*'s grading system: rank correlation was high $r = 0.93$ and $p = 0.0027$. The readings taken from the two filter bars in the clinical test were analysed. Correlation was high $r = 0.95$, $p = <0.001$ (Student's *t* test).

The same analysis was carried out after substituting the log of the photometric value into the clinical data. Again correlation was high $r = 0.92$, $p = <0.001$ (Student's *t* test) (Table 2).

DISCUSSION

The Sbisa bar is much more available than NDFs in most departments and most orthoptists have one to hand. In our experience quantification of RAPD is not frequently done despite research showing its value in the management of CRVO.² We propose that one of the reasons is the scarcity of NDF. By showing that a Sbisa bar can be used to accurately and reliably quantify RAPD, this method may be used more frequently.

Ramsay *et al* have shown that crossed polarised filters produce exponential attenuation of light and can be used in the same way as NDF to assess RAPD in CRVO.⁷ This instrument is scarce in most departments.

Servais *et al* quantified RAPD using NDF in patients with CRVO²; 90% of non-ischaemic CRVO had an RAPD of 0.3 log unit or less and none greater than 0.9. Ischaemic CRVO had RAPD of 1.2 or greater in 91% and none less than 0.6. It would be speculation to say that the Sbisa bar can be used to assess ischaemia in CRVO and this study did not set out to answer this question. A further study repeating that of Servais with a Sbisa bar would be needed. We conclude that NDF 0.6 = 1 Sbisa; 0.9 = 4; 1.2 = 9; and 2.7 = 15 approximately, but we cannot draw conclusions about ischaemia in CRVO when using the Sbisa bar to quantify RAPD.

Even though the order the tests were performed was varied, the result of the first may have influenced the second. Despite definition of the end point when using filters, subjective errors may have occurred at this stage. While Sbisa bar filters are red and NDF neutral it is the apparent brightness not colour that determines pupil response.⁸ Measurement of luminance (cd/m^2) for the filters accounted for this.

The authors recommend practice of the technique before full clinical use. We found that the first few swings of the test produced variable pupil responses, which we thought were due to retinal adaptation, and we ignored these. We also found that after 6–7 swings the pupil responses again started to vary which we attributed to asymmetrical retinal bleaching caused by the filter. We attempted to overcome this by removing the filter for a couple of swings before resuming the test. We recorded the result of the test as the filter number (see text) that produced reversal of the RAPD.

In conclusion, the Sbisa bar is a comparable instrument to the NDF bar in measuring RAPD. Its availability in the clinical situation makes it practical.

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Authors' affiliations

A McCormick, R Bholra, L Brown, D Squirrel, J Giles, I Pepper,
Department of Ophthalmology and Orthoptics, A floor, Outpatients,
Royal Hallamshire Hospital, Glossop Road, Sheffield S10 2JF, UK

Correspondence to: Mr Austin McCormick;
austin@austinmccormick.demon.co.uk

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