Functional Vision Assessment: Looking Beyond Clinical Measures of Ocular Function

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ABSTRACT

Clinical measures of ocular function are commonly used by orthoptists in a variety of settings. However, investigation of functional vision is not often assessed nor quantified. This paper utilises three case reports to highlight the importance of investigating functional vision and describes the use of one such tool useful for this purpose.

Keywords: Functional vision assessment, activities of daily living, clinical vision tests.

INTRODUCTION

Assessment of visual acuity is one of the most important and most efficient tests performed by orthoptists in a wide variety of clinical settings. Visual acuity as measured on a Snellen chart or similar is often the best way to determine the functioning of the fovea. Other clinical tests such as contrast tests, stereopsis, colour vision and visual fields can also provide information about ocular functioning. Whilst these clinical tests of ocular function provide much information, they may not accurately determine the functional vision of a patient[1,2]. Functional vision can be described as the level of a person's functioning whilst performing vision-related activities. These activities include activities of daily living such as reading, writing, recognising faces, driving and walking. Assessment of functional vision is commonly conducted in the vision rehabilitation setting when planning rehabilitation strategies; however it is not commonly investigated in ophthalmic clinics[3-6]

There are several tests for determining functional vision and the Visual Functioning Questionnaire (VF-14) is one such test[7-11]. It comprises of 18 questions covering 14 aspects of general functioning including reading, leisure tasks, mobility, and driving; the format of the questionnaire is shown in Table 1. Although this tool was originally developed to measure functional impairment caused by cataract, it was found to have high internal validity and the general functioning questions relate to common daily tasks performed by people of varying age, including young adults and the elderly[10]. It is easily administered and is not time consuming for the patient or clinician as the average time taken to respond is between 5 and 10 minutes. A percentage score is calculated based on responses from the patient and a person with no vision problems would expect to score 100%.

The aim of this paper is to highlight how the VF-14 has been a useful tool to document functional vision and investigate ability to perform daily living tasks. Three case studies will be used to illustrate the type of information that a functional vision test can provide beyond the information that can be gathered using clinical tests of acuity, contrast sensitivity, stereopsis and colour vision.

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CASE REPORTS

Case Study 1

BC, a nineteen year old female, presented for assessment of functional vision for medico-legal purposes. She had been hit by a glass in the right eye almost 12 months prior and had sustained a small blow out fracture of the orbital floor. There was no entrapment of the eye, extra-ocular muscles or the optic nerve. Optical Coherence Tomography (OCT) revealed a small central foveal defect in the form of a foveal microhole in the right eye (Figure 1). The left eye was unremarkable.

BC's main complaint was difficulty seeing things she could easily see prior to sustaining the injury. She reported problems identifying small numerals and complained of a 'yellow tint' over objects. Snellen visual acuity was 6/6 (-1)

Table 1: The VF-14 questionnaire

Question		Rating*
1.	Do you have any difficulty, even with glasses, reading small print, such as labels on medicine bottles, a telephone book, food labels? Yes ☐ No ☐ Not applicable ☐ If yes, how much difficulty do you have?	0 1 2 3 4
2.	Do you have any difficulty, even with glasses, reading a newspaper or a book?	0 1 2 3 4
3.	Do you have any difficulty, even with glasses, reading a large-print book or large-print newspaper or numbers on a telephone? Yes ☐ No ☐ Not applicable ☐ If yes, how much difficulty do you have?	0 1 2 3 4
4.	Do you have any difficulty, even with glasses, recognizing people when they are close to you? Yes ☐ No ☐ Not applicable ☐ If yes, how much difficulty do you have?	0 1 2 3 4
5.	Do you have any difficulty, even with glasses, seeing steps, stairs or curbs?	0 1 2 3 4
6.	Do you have any difficulty, even with glasses, reading traffic signs, street signs, or store signs? Yes ☐ No ☐ Not applicable ☐ If yes, how much difficulty do you have?	0 1 2 3 4
7.	Do you have any difficulty, even with glasses, doing find handwork like sewing, knitting, crocheting, carpentry? Yes ☐ No ☐ Not applicable ☐ If yes, how much difficulty do you have?	0 1 2 3 4
8.	Do you have any difficulty, even with glasses, writing checks or filling out forms?	0 1 2 3 4
9.	Do you have any difficulty, even with glasses, playing games such as bingo, dominos, card games, mahjong? Yes ☐ No ☐ Not applicable ☐ If yes, how much difficulty do you have?	0 1 2 3 4
10.	Do you have any difficulty, even with glasses, taking part in sports like bowling, handball, tennis, golf? Yes ☐ No ☐ Not applicable ☐ If yes, how much difficulty do you have?	0 1 2 3 4
11.	Do you have any difficulty, even with glasses, cooking? Yes ☐ No ☐ Not applicable ☐ If yes, how much difficulty do you have?	0 1 2 3 4
12.	Do you have any difficulty, even with glasses, watching television? Yes ☐ No ☐ Not applicable ☐ If yes, how much difficulty do you have?	0 1 2 3 4
13.	Do you currently drive a car? Yes ☐ Go to 14 No ☐ go to 16	
14.	How much difficulty do you have driving during the day because of your vision? No difficulty ☐ A little difficulty ☐ A moderate amount of difficulty ☐ A great deal of difficulty ☐	
15.	How much difficulty do you have driving at night because of your vision? No difficulty ☐ A little difficulty ☐ A moderate amount of difficulty ☐ A great deal of difficulty ☐	
16.	Have you ever driven a car? Yes ☐ Go to 17 No ☐ Stop questionnaire	
17.	When did you stop driving? Less than 6 months ago ☐ 6-12 months ago ☐ More than 12 months ago ☐	
18.	Why did you stop driving? Vision ☐ Other illness ☐ Other reason ☐	

* Ratings correspond to 1 = A little; 2 = A moderate amount; 3 = A great deal; 4 = Are you unable to do the activity?

in the right eye, 6/4 in the left eye. Near acuity using the Bailey-Lovie Word Reading Chart (BLWRC) was N5, slow and patchy in the right eye and N4 fluent with the left eye. She had right ocular dominance and extensive questioning revealed that she had started the process of adaptation to left ocular dominance. BC's colour vision (City University Colour Vision Test (CUCVT)) was normal in both eyes, but her contrast sensitivity (Sine Wave Contrast Test (SWCT)) whilst within the normal range, showed a decrease at 6, 12 and 18 cycles per degree in her right eye compared

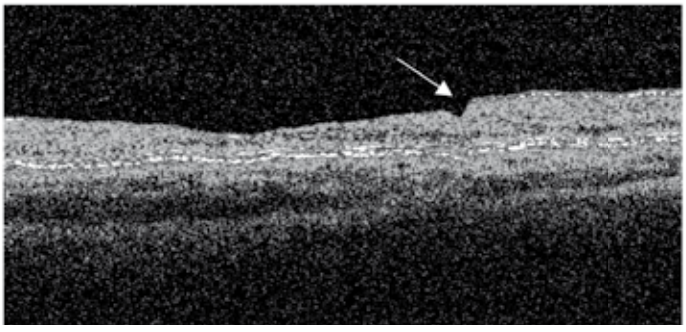

Figure 1. OCT of the right eye, the arrow indicating the foveal microhole.

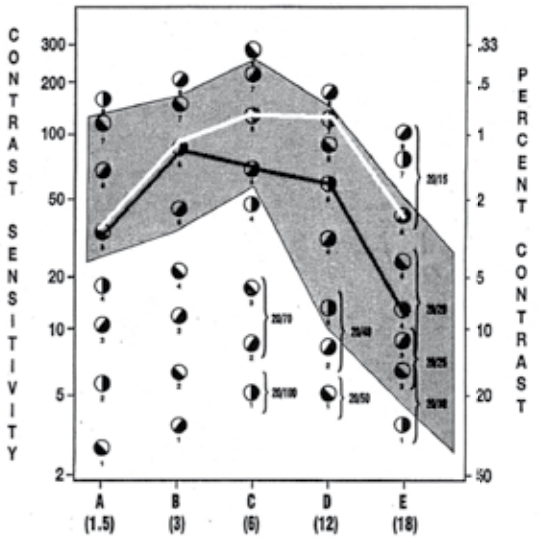

Figure 2. Contrast sensitivity test of the right eye (black line) and left eye (white line)

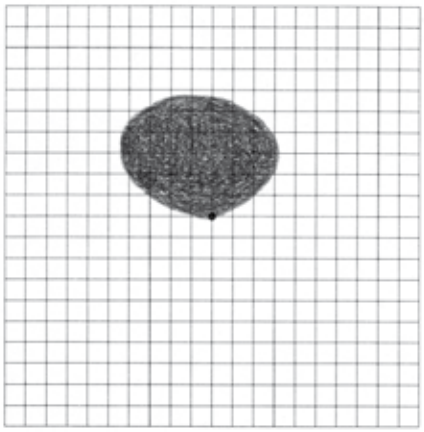

Figure 3. Amster grid defect of the right eye

Assessment of her central vision (Amsler) showed a small paracentral area of distortion and blur superiorly (Figure 3). Stereopsis (Titmus) was reduced to 200" arc.

Case Study 2

Twenty one year old male, JR, developed phototoxic maculopathy in both eyes after prolonged welding without appropriate ocular protection. He presented for a medico-legal assessment of functional vision almost 4 years after the injury and complained of difficulty focusing and particular difficulty reading small print. Fundoscopy showed sub-foveal retinal pigment epithelium de-pigmentation in both eyes. OCT examination confirmed this finding and central foveal destruction is evident (Figure 4). The retinal pigment epithelium and photoreceptors are absent and this is consistent with phototoxic maculopathy.

Snellen visual acuity was found to be 6/12 in both eyes and near acuity was N8 (BLWRC) in both eyes. Colour vision testing (CUCVT) revealed difficulty in the Chroma 2 spectrum, although no specific protan, deutan or tritan loss was evident. Contrast sensitivity (SWCT) showed that his contrast was reduced at 1.5 and 6 cycles per degree with the remaining spatial frequencies at the lower end of the normal range (Figure 5). Stereopsis (Titmus) was 200" arc.

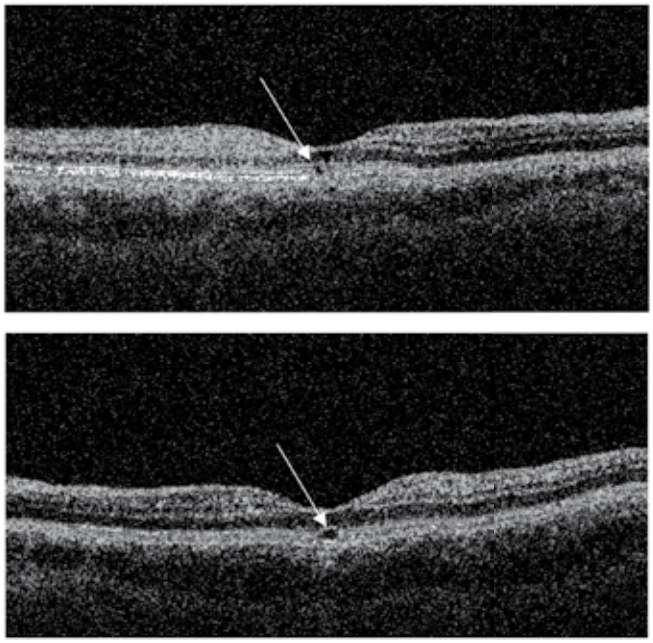

Figure 4. OCT of the right eye (top) and left eye (bottom), the arrow showing the central photoreceptor destruction

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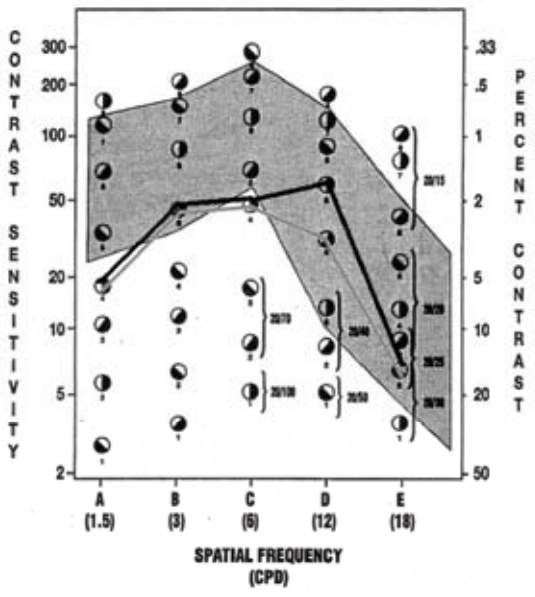

Figure 5. Contrast sensitivity test of the right eye (black line) and left eye (grey line)

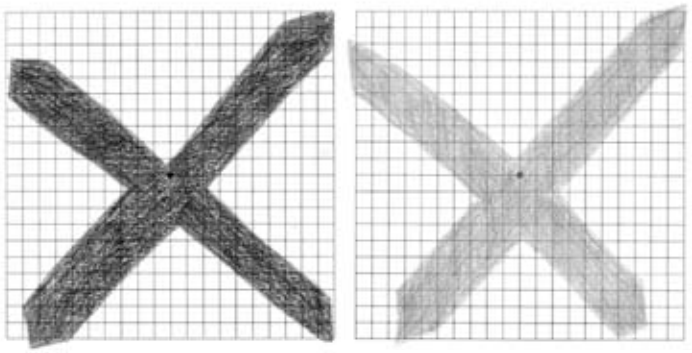

Figure 6. Amsler of the right eye (back) and left eye (grey)

significant defect was found on the Amsler grid in the form of an X-pattern (Figure 6). As JR needed to make constant re-fixations to the centre fixation target in order to see it due to the presence of a non-absolute scotoma, the X-shaped artefact, which he describes as the area where the lines are faded, appears on the grid.

Case Study 3

BW, a 38 year old male, presented for assessment of functional vision as he was seeking employment. Unlike the previous case studies, BW presented with a congenital ocular condition. He reported a history of congenital toxoplasmosis with ocular involvement. Fundus photography shows old retinal toxoplasmosis scarring in both eyes (Figure 7).

BW did not present with any ocular complaints but his potential employer wanted confirmation that he was able to do certain tasks outlined in the job description for the work he was applying for. His best-corrected visual acuity (Snellen) was 6/60 and 6/24 (-1) in the right and left eye respectively and near acuity (BLWRC) was N8 in the right and N6 in the left eye, fluently. Whilst there was no colour vision defect found (CUCVT), his contrast sensitivity (SWCT) was severely reduced in both eyes (Figure 8) and he had no stereopsis response (Titmus). Neither an Amsler grid assessment nor OCT was performed.

VF-14 RESULTS

Each of these patients was asked to complete the VF-14 questionnaire. Based on the clinical tests of ocular function, it was expected that both BC and JR would score the highest, whilst BW would score lowest due to his severely reduced distance visual acuity. However the opposite was true. BC scored 89% on the VF-14 and the test highlighted that she had difficulty reading small print such as that found on medicine bottles, reading newsprint, filling out forms and a great deal of difficulty doing fine

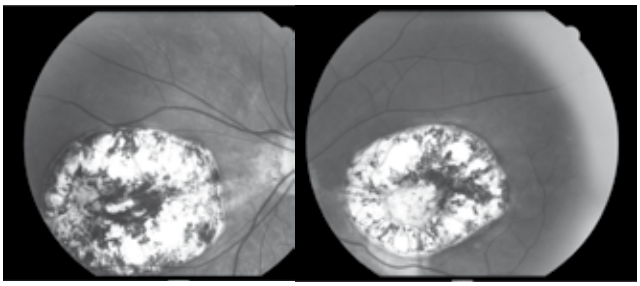

Figure 7. Fundus photography of the right and left eye

handiwork such as sewing. This was especially important to her as dancing was one of her hobbies and she often assisted with making her own costumes. Difficulty with sewing or fine handiwork was not a problem for her prior to her injury. JR's VF-14 score was the most reduced, at 43% and the test revealed that he was functioning very poorly with this ocular injury, despite the fact that his visual acuity was at 6/12. He had difficulty reading small print, traffic signs, filling in forms, watching television and playing sport. The severe impact of the injury on his ability to discriminate fine detail was having a profound impact on his ability to work as a carpenter and he required more time to perform standard tasks required of him in his workplace. BW scored 99% on the VF-14 questionnaire score and he expressed only a very mild problem reading small print.

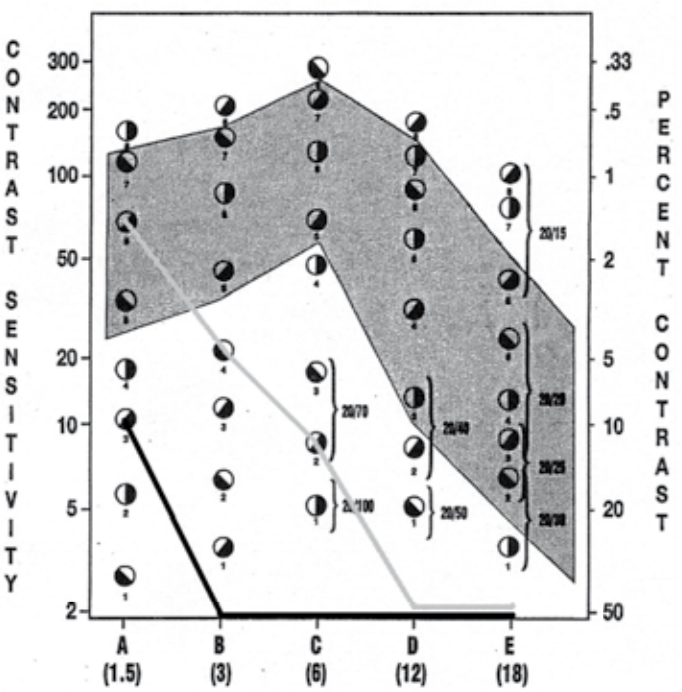

Figure 8. Contrast sensitivity test of the right eye (black line) and the left eye (grey line)

Table 2: Summary of clinical measures for each case			
Clinical Test	**BC**	**JR**	**BW**
Distance VA	R) 6/6 L) 6/4	R) 6/12 L) 6/12	R) 6/60 L) 6/24 (-1)
Near VA	R) N5 L) N4	R) N8 L) N8	R) N8 L) N6
Colour vision	Normal	Reduced++ in chroma 2 range (otherwise normal)	Normal
Contrast sensitivity	R) slightly reduced L) normal	At the lower end of normal	Severely reduced

DISCUSSION

Whilst standard clinical tools of acuity, colour vision, contrast, stereopsis and visual field assessment can provide much information about the patient's ocular health; these tests are not able to quantify functional vision. Exactly determining which daily living tasks a patient with vision problems may be having requires careful questioning. As these three cases indicate, those with the worst performance on clinical tests may not always function poorly whilst undertaking activities of daily living. The congenital nature of BW's ocular problem most likely accounted for the very slight impact his vision impairment had in his life, as opposed to BC and JR who acquired their ocular injury and had not yet had time to make daily living skill adaptations. Had the clinical measures of vision been considered without the functional tests (a summary of these is shown in Table 2) one would conclude that JR and BC were functioning at normal or near-normal levels. However, BW had a higher level of functional vision compared with the other two cases, despite having the worse distance visual acuity.

Tests of functional vision, such as the VF-14 are extremely useful tools for identifying problem areas and can provide insightful information about how a person functions in their daily life, even if their vision and other tests appear to show very small clinical defects. Tools such as this provide much information about patients who are very symptomatic, despite performing well on clinical measures of ocular function. Had the VF-14 not been performed on these three patients, there would have been little insight into the problems faced by them in day to day functioning and the assumption that BW is the most severely impaired in terms of functioning may be made, despite the fact that the opposite is true. Functional vision assessment tools are underutilised in the ophthalmic and sometimes rehabilitation setting. The VF-14 is an inexpensive tool which is easily administered and scored in any clinical setting and has the ability to provide extremely useful information about the functional visual capacity of a patient.

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Acknowledgements: Thank you to Dr Wilson Heriot, Ms Stavroula Stylianou and Ms Danielle Thorburn for their assistance with the OCT images and other information used in this paper