

VISION ACADEMY VIEWPOINT

The Vision Academy is a partnership between Bayer and ophthalmic specialists, established with the aim of addressing key clinical challenges in the field of retinal diseases: www.visionacademy.org.

Additional Measures of Macular Function Beyond Visual Acuity

Background

Visual function is a complex process involving multiple interactions between the eye and the brain. Although visual acuity (VA) is the most commonly used measure of visual function, it only provides a partial representation of a patient's overall visual function.¹⁻⁴

Retinovascular diseases can affect different aspects of visual function, such as contrast sensitivity, color and shape discrimination, and dark adaptation, without affecting VA.^{2,5,6}

VA is therefore only one aspect of visual function, and in some cases it is not enough to evaluate visual function in patients with retinal disease.² In addition, VA measurements may not be sensitive enough to detect the slow progression of all components of visual function.⁷ As a result, new functional endpoints are required to fully understand the early stages of macular disease, its progression, the response to treatment, and the impact on patients' quality of life.

A review of the literature and available evidence was conducted to:⁸

- Describe additional measurements of visual function beyond acuity
- Provide recommendations on their application in the management of retinovascular diseases such as age-related macular degeneration (AMD), diabetic macular edema (DME), and retinal vein occlusion

Endorsed by the Vision Academy in November 2023.

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Full consensus



Variations in opinion

Viewpoint

Many additional tests are available, each with their own advantages and limitations, that may be complementary to VA and provide a more comprehensive measure of visual function. In particular, the use of low-luminance VA, contrast sensitivity, retinal fixation and microperimetry, and reading performance in addition to VA is recommended for the assessment of overall visual function. Several measures that require further optimization and standardization before being widely implemented in clinical practice are also available. A summary of Vision Academy recommendations for measuring visual function in the management of retinovascular diseases is presented in the following table:

Measure	When, where, and why to use the measure	Advantages	Barriers to use in clinical practice and/or clinical trials	Specific recommendations for application
Recommended measures of visual function⁸ 				
Low-luminance VA	<ul style="list-style-type: none"> • Indications: AMD, DME, CSCR, PDR (PRP), IRD • Follow-up for patients with dry AMD 	<ul style="list-style-type: none"> • Simple, inexpensive, and rapid measure 	<ul style="list-style-type: none"> • Should be well explained to the patient to inform them that BCVA will naturally drop 	<ul style="list-style-type: none"> • Use a 2.0-log unit neutral-density filter • Larger benefit in non-neovascular AMD • A self-administered test could be considered
Contrast sensitivity	<ul style="list-style-type: none"> • Indications: AMD, DME, refractive surgery, CSCR, PDR (PRP), IRD • After PRP in patients with diabetes as they often experience visual discomfort with good VA • Evaluation of patients for whom VA does not match their reported visual problems 	<ul style="list-style-type: none"> • Rapid measure • Linked to vision-related QoL 	<ul style="list-style-type: none"> • Variability of results • Influenced by media opacities, namely cataracts 	<ul style="list-style-type: none"> • Use of a computer-controlled screen is preferable
Retinal fixation and microperimetry	<ul style="list-style-type: none"> • Indications: AMD, DME, vitreo-retinal disorders, retinotoxicity disorders, macular dystrophies, IRD • Better correlation and understanding of morphology (i.e., imaging) and function, especially retinal sensitivity 	<ul style="list-style-type: none"> • Good correlation between retinal fixation and reading performance 	<ul style="list-style-type: none"> • Equipment is not available at all retinal clinics • Long testing duration traditionally, but duration has improved with recent developments 	<ul style="list-style-type: none"> • Use short-duration testing strategies • Print out results with probability maps of disease progression • Use to determine fixation in advanced AMD
Reading performance	<ul style="list-style-type: none"> • Indications: AMD, DME, vitreo-retinal disorders, refractive surgery • Follow-up visits to evaluate response after anti-VEGF treatment for AMD or DME • Better assessment of the impact of visual impairment on QoL than ETDRS charts 	<ul style="list-style-type: none"> • Strongly linked to vision-related QoL 	<ul style="list-style-type: none"> • Lack of standardization • Lack of agreement on methodology • Depends on a patient's literacy 	<ul style="list-style-type: none"> • Example: Radner reading charts • Comparability needs to be ensured • May be performed uni- or binocularly

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Always refer to local treatment guidelines and relevant prescribing information.

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Measure	When, where, and why to use the measure	Advantages	Barriers to use in clinical practice and/or clinical trials	Specific recommendations for application
Measures of visual function requiring further optimization⁸ 				
Dark adaptation	<ul style="list-style-type: none"> • Indications: AMD, DME, PDR (PRP) • To differentiate AMD from variants of genetic disease • Early diagnosis of AMD progression if short-duration testing strategies prove effective 	<ul style="list-style-type: none"> • Assesses photoreceptor dynamic response 	<ul style="list-style-type: none"> • Lack of standardization • Long testing duration (time-consuming) • Requires special examination equipment and conditions which are not always available (i.e., a dedicated dark room) 	<ul style="list-style-type: none"> • Use short-duration testing strategies
Binocular vision testing	<ul style="list-style-type: none"> • Indications: neurologic disorders, squinting, IRD, nystagmus • Driver's license testing in some countries • Evaluation of real-life visual performance for medical or legal purposes 	<ul style="list-style-type: none"> • Meaningful for real-life activities • Strongly linked to vision-related QoL 	<ul style="list-style-type: none"> • Underestimation of monocular visual changes • Lack of standardization 	Not applicable
Color vision testing	<ul style="list-style-type: none"> • Indications: primarily DR and DME • Driver's license testing in some countries • Neurological disorders • IRD 	<ul style="list-style-type: none"> • Easily performed • Standardized (printed charts) 	<ul style="list-style-type: none"> • Influenced by media opacities, namely cataracts • Tests a different function from visual discrimination, so there is limited correspondence with other tests 	<ul style="list-style-type: none"> • Use of Cambridge Colour Test or other computerized tests is faster than the classic print-based tests (e.g., Ishihara, Farnsworth)
Visual recognition tests	<ul style="list-style-type: none"> • Indication: AMD • To differentiate from neurological or cognitive disorders such as Charles Bonnet syndrome 	<ul style="list-style-type: none"> • Linked to vision-related QoL 	<ul style="list-style-type: none"> • Lack of standardization • Limited relevance for monitoring AMD progression 	Not applicable
Shape discrimination	<ul style="list-style-type: none"> • Indications: AMD, DME • To differentiate from neurological or cognitive disorders such as Charles Bonnet syndrome 	<ul style="list-style-type: none"> • Linked to vision-related QoL 	<ul style="list-style-type: none"> • Lack of standardization 	<ul style="list-style-type: none"> • Can be used for self-monitoring of AMD

AMD, age-related macular degeneration; BCVA, best-corrected visual acuity; CSCRC, central serous chorioretinopathy; DME, diabetic macular edema; DR, diabetic retinopathy; ETRDS, Early Treatment Diabetic Retinopathy Study; IRD, inherited retinal disease; PDR, proliferative diabetic retinopathy; PRP, panretinal photocoagulation; QoL, quality of life; VA, visual acuity; VEGF, vascular endothelial growth factor.

Further considerations

Current measures of VA are relatively insensitive to early progression of retinovascular diseases and this can present challenges in clinical trials.⁷ In addition, there is an unmet need to differentiate the long-term effect of intravitreal drugs, mainly in neovascular AMD where best-corrected VA appears to be unchanged.



While this Viewpoint largely focuses on AMD and DME, these measures are also applicable to other retinal diseases, such as inherited retinal diseases.⁹⁻¹² Other methods of visual function testing, such as multifocal electroretinograms and multifocal visual evoked potentials, can be valuable in the differential diagnoses of retinal and optic nerve diseases,¹³⁻¹⁶ while frequency-doubling technology perimetry can be applied as an alternative exploratory method to identify visual field defects in optic nerve-related diseases.^{17,18}

Additional tests to measure and quantify other aspects of visual function have shown promising results in independent studies.¹⁹⁻²¹ Some tests are closer to being used in clinical practice, such as contrast sensitivity, retinal fixation, low-luminance VA, and reading performance. Considerations for new tests include their ability to evaluate several functional parameters, whether they can be used for all retinal diseases, the time needed to perform the test, and whether they are highly reproducible.

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