
DIGITAL VS MANUAL EVALUATION IN EARLY ARM

2010: Rufino Silva, J.R. Faria de Abreu, M. Luz Cachulo, João Diogo Ramos, João Pinto, Nelson Vilhena, J.G. Cunha-Vaz

TAKEAWAY

Novel RetmarkerAMD grading software is less error-prone, is more effective than manual grading (significant time savings - 35% faster) and it is also more accurate

RetmarkerAMD provides the basis for monitoring the progression of lesions from early to late AMD



Digital Vs manual evaluation in early ARM

Rufino Silva^{1,2}, J.R. Faria de Abreu¹, M. Luz Cachulo^{1,2}, João Diogo Ramos³, João Pinto³, Nelson Vilhena³, J.G. Cunha-Vaz²

1- AIBILI - Association for Innovation and Biomedical Research on Light and Image. Coimbra. Portugal

2- Ophthalmology Department. University Hospital of Coimbra. Coimbra.

3- Portugal Critical Health. Coimbra. Portugal

Introduction:

Age-related maculopathy (ARM) is a degenerative disorder of the central area of the retina (the macula) often associated with visual impairment which is more frequent after 65 years of age¹. It is the leading cause of visual loss in those over the age of 50 years in the developed world. The more commonly used classification – the International Classification¹ – describes early stages of the condition as age-related maculopathy (ARM), and later stages as age-related macular degeneration (AMD). ARM refers to the presence of drusen and retinal pigment epithelium (RPE) irregularities, and AMD refers to more advanced stages of the condition.

Quantification of change in AMD images is vital for use as an outcome measure in clinical trials investigating new treatments and prevention strategies. Several studies have compared digital photographs and stereoscopic digital photographs with regard to their use in grading of AMD changes and concluded that digital imaging is reliable for the purpose of grading AMD and for using this grading system in epidemiological studies^{1,2,3}. The results of these studies also support the use digital images of AMD patients with the International Classification System. Digital images (stereoscopic and non-stereoscopic) were also compared with 35-mm color transparencies with regard to the quality and reliability of grading age-related macular disease and were found to be reliable for the purpose of grading age-related macular disease using this grading system in epidemiological studies^{4,5}. This means that digital imaging can be employed for grading AMD features in clinical practice or in clinical trials.

The time and expense involved in manual grading can be reduced with the development of automated image analysis systems, but they are not yet widely used in clinical or research settings. However, the use of digital photography is now more common, and investigation into the use of established grading scales with digital, as opposed to analog images, has shown that it is a convenient and versatile way of imaging and grading the fundus.

Material and methods

A new software - the Retmarker AMD – was developed as a solution to assist graders in grading different types of AMD lesions and automatically computing their number, size and location. This solution was intended to assist and streamline the process of grading AMD eye colour fundus images within the context of an epidemiological study on AMD. Data created in RetmarkerAMD is then exported to feed other systems.

The International Classification Grading System was assumed for this software and five circles (C0, C1, C2, C3, and C4) of 63, 125, 175, 250 and 500 μm were used for lesions grading. All circles may be used for estimation of drusen size. Circles C1 and C2 may be used for grading area involved by increased pigmentation or RPE depigmentation, circle C2 for minimum area of geographic atrophy, and C3 and C4 for area of geographic atrophy or neovascular AMD. The system components were prototyped to allow to: i) differentiate graded/non-graded images; ii) assess images in full screen view; iii) draw free forms over the images, iv) draw preset circular objects, of different colour codes and sizes (63 μm - 500 μm) to represent drusen,

hyperpigmentation, hypopigmentation geographic atrophy and exudative lesions; v) allow drusen marks to be confluent; vi) zoom in/out the image or display an image area with a higher/lower degree of magnification; vii) measure distances in the image; control RGB channels, brightness and contrast; viii) superimpose a standard grid to identify eye sub-fields; ix) manually enter data for study protocol questionnaire.

Each image is calibrated, before any measurement is performed, using the optic disc diameter (1, 5 mm) as a reference. In this system, all ARM signs within a fixed area (diameter, 6000 μm) around the fovea are recorded. The area is delineated by a grid consisting of three concentric circles and a right angled cross at 45° and 135° to the horizontal, which is adjusted according to the previous calibration. The diameters of the central, inner, and outer circle are 1000 μm , 3000 μm and 6000 μm , respectively, the same used by the International Classification System. The fundus signs that are allowed to be graded by this tool include: number of drusen (<63 μm , ≥ 63 to <125 μm , and ≥ 125 μm); drusen type (hard; soft distinct, <125 μm ; soft distinct, ≥ 125 μm ; soft indistinct; reticular); total area occupied by drusen (<1%, <10%, <25%, <50%, $\geq 50\%$, for central, inner, and outer circle separately); confluence of drusen (absent, <10%, <50%, $\geq 50\%$); hyperpigmentation (absent, <125 μm , <175 μm , ≥ 175 μm) and hypopigmentation of the retinal pigment epithelium (absent, <175 μm , ≥ 175 μm), atrophic AMD; and neovascular AMD.

Results:

Preliminary results from comparative tests have shown that RetmarkerAMD is more effective than manual grading allowing significant time savings (overall, it is 35% faster) and is more accurate (improved accuracy: overall 32% more lesions indentified). The automatic way to calculate the number of lesions, their areas and locations, and the distance from the fovea reduces the margin for human error and time consuming (roughly 50% of the graders time when doing manual grading). It allows standardizing lesion documentation improves agreement rates between graders and provides the basis for monitoring the progression of lesions from early to late AMD.

Conclusions:

The implementation of this new tool for grading digital colour images in epidemiological studies on AMD can be very useful for measuring lesions and assessing their progression while it simplifies the procedures, introduces more accuracy and reduces the time consuming. It can be used as a platform to run epidemiological studies and to evaluate AMD progression.

1.C. Bird, N.M. Bressler, S.B. Bressler, I.H. Chisholm, G. Coscas, M.D. Davis, P.T.V.M. de Jong, C.C.W. Klaver, B.E.K. Klein, R. Klein, P. Mitchell, J.P. Sarks, S.H. Sarks, G. Soubrane, H.R. Taylor, and J.R. Vingerling. An International Classification and Grading System for Age-related Maculopathy and Age-related Macular Degeneration. The International Epidemiological Study Group.

2- van Leeuwen R, Chakravarthy U, Vingerling J, et al: Grading of age-related maculopathy for epidemiological studies. Is digital imaging as good as 35-mm film? *Ophthalmology* 110:1540--4, 2003

3-Klein R, Meuer S, Moss S, et al: Detection of age-related macular degeneration using a non-mydratic digital camera and a standard film fundus camera. *Arch Ophthalmol* 122:1624--46, 2004.

4-Scholl H, Dandekar S, Peto T, et al: What is lost by digitizing stereoscopic fundus colour slides for macular grading in age-related maculopathy and degeneration? *Ophthalmology* 111:125--32, 2003

5-van Leeuwen R, Chakravarthy U, Vingerling J, et al: Grading of age-related maculopathy for epidemiological studies. Is digital imaging as good as 35-mm film? *Ophthalmology* 110:1540--4, 2003