maia

Macular Integrity Assessment


# Microperimetry Handbook

First Edition

# Introduction

Microperimetry also known as fundus-related perimetry, correlates retinal morphology and function. It combines fundus imaging, retinal sensitivity mapping and fixation analysis in one exam and has been used over a decade as a powerful tool to detect, describe and follow-up pathologies affecting the macular area. Its great advantage is the ability to record and control a patient's fixation activity while measuring visual field, hence eliminating errors caused by fixation losses.

The purpose of this MAIA Handbook is to show Eye Care professionals some examples of MAIA microperimetry capabilities during the analysis of retinal function in different clinical cases from retina practice to low vision centers.

# Index

# Basic Concepts Related to MAIA Microperimetry

MAIA is the 3rd generation of microperimetry instruments and the first easy to use device of its kind. MAIA microperimeter technology combines 3 different techniques in the analysis of the retinal function: a) Retinal Imaging, b) Analysis of retinal sensitivity sensitivity and c) Analysis of fixation capabilities.

## Retinal Imaging

In MAIA, the retinal image is created by means of a Scanning Laser Ophthalmoscope (SLO). The SLO is a confocal technology widely used in the analysis of retinal morphology thanks to the high-resolution image quality.

It is a non mydriatic instrument and does not require a flash to image the retina. Images can be obtained even in the presence of media opacity such as mild cataract.

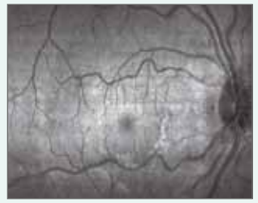


Image of the MAIA Scanning Laser Ophthalmoscope (SLO).

## Analysis of Retinal Sensitivity

Microperimietry, similarly to standard automated perimetry (SAP), measures retina sensitivity as the minimum light intensity that patients can perceived when spots of light stimulates specific areas of the retina. The exam can be customized with different number of stimuli covering a variable field of vision. The standard MAIA test covers a 10° diameter area with 37 measurement points. In MAIA, light stimuli are created by a white LED and projected directly on the retina surface. The stimuli size are Goldmann III, background luminance is 4 asb and maximum luminance is 1000 asb, with a 36 decibels (dB) dynamic range.

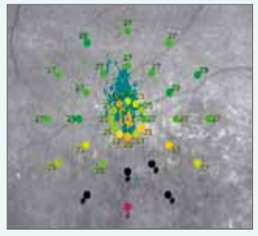


Image of the standard MAIA sensitivity grid map.

### Decibel Scale (dB)

In perimetry, the stimuli luminance is measured in apostilbs (asb). An apostilb is an absolute unit of luminance and is equal to 0.3183 candela/m2. The decibel scale is a relative scale which depends on the maximum intensity that perimetry instruments can emit. It is an inverted logarithmic scale where zero decibels is set as the brightest stimulus that the perimeter can produce. The decibel scale is not standardized because the maximal luminance varies between instruments. The decibel value range is calculated among the minimum and the maximum intensity level of the projected stimuli. Therefore physicians shall be careful when comparing results in decibels from different instruments with different maximum intensity of stimuli projection. The decibels scale is color-coded according to the MAIA normative studies where "green" represent normal values, "yellow" suspect, "red" abnormal and "black" represents scotoma as shown in the graphic below.


Image of the MAIA dB color scale

### Projection Strategy

In order to measure the minimum retinal sensitivity over a specific area, the Goldmann III light stimuli may be projected on the same spot several times at different light intensities following a "projection strategy". MAIA can work with 3 different projection strategies (software version 1.7.0, January 2013); the full threshold 4-2, the 4 Levels Fixed (4-LF) and the Scotoma-Finder (SF).

Maia 4-2 follows the perimetric standard. It changes the light intensity in 4dB steps until there is a change from not seen to seen (or from seen to not seen). Then the intensity changes in 2db steps until the stimulus is not seen again. The standard MAIA test using 4-2 strategy has an average duration of 5.5 minutes.

The 4-Levels-Fixed (4-LF) is a supra-threshold strategy designed to have a fast assessment of retina sensitivity on patients with known pathologies. It projects 4 different stimuli intensities: 25 dB, 15 dB, 5 dB, and 0 dB. With this strategy, Maia provides an initial assessment of "good", "medium", "bad" or "scotomatous" retinal sensitivity. The standard MAIA test using the 4-LF has an average duration of 2.5 minutes.

The Scotoma Finder (SF) is a supra-threshold strategy designed for patients with severely affected central vision and provides information concerning progression of the "blind" area. SF strategy projects only 0dB stimuli. MAIA test using the SF strategy has an average duration of 1.5 minutes.

### Macular Integrity Index

The Macular integrity index is a numerical value (not dB) that describes the likelihood that a patient's responses, are normal, suspect or abnormal when compared to age-adjusted normative data. It does not represent the severity of the disease process. Higher numbers suggest a greater likelihood of abnormal findings, while lower values suggest a greater likelihood of normal findings. There is no direct relationship between the average threshold value (dB) and the macular integrity index. In fact it is possible for the average threshold to be normal while the macular integrity index is abnormal. This index is only present in exams performed with the standard MAIA stimuli grid and the 4-2 projection strategy.


Example of abnormal macular Integrity Index with Normal averaged dB values

## Analysis of Fixation and the Preferred Retinal Locus (PRL)

### Fixation Location (PRL)

Fixation is the process of attempting to "look at" a selected visual target and consists of optically aligning a functional area of the retina to that target.

In normal subjects the retinal area predominantly used for fixation is the fovea, whereas when pathology affects the central retina, fixation degrades and patients develop a condition known as eccentric viewing and use extra-foveal regions.
In general, the retinal area used to attempt fixation is known as the Preferred Retinal Locus (PRL).

MAIA provides accurate and objective information regarding retinal location and stability of a patient's fixation. Such parameters are assessed by tracking eye movements 25 times / sec and by plotting the resulting distribution over the SLO image.
Each movement is represented by a point in the distribution. The overall cloud of points describes the PRL.

### PRL_initial (PRLi) and PRL_final (PRLf)

MAIA identifies 2 main PRL reference points calculated as the barycenter of the cloud of fixation points known as PRL_initial and PRL_final. The first one is found in the first ten seconds of the exam, when patients make their highest effort to hold a steady fixation.

The PRL_initial defines the center of the MAIA stimuli grid.

The second one is found at the end of the MAIA test and it serves as the reference point to calculate fixation stability. Patients with stable fixation will present both PRLs in the same anatomical location, while bigger distance among PRL's will determine more unstable fixation conditions and less visual acuity.

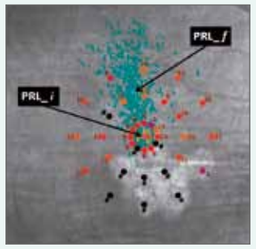



Image of PRL_initial and PRL_final.

### Fixation Stability

Fixation stability is measured in 2 different ways:

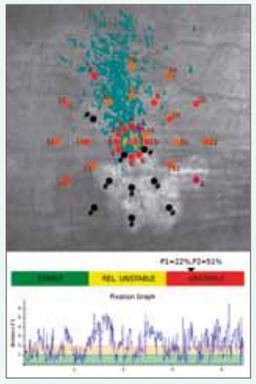
- Calculating the percentage of fixation points (%) located within a distance of 1° and 2° respectively (P1 and P2).

  The classification of stability is based on the following criteria:

  1. If more than 75% of the fixation points are located within P1, the fixation is classified as "stable".
  2. If less than 75% of the fixation points are located within P1, but more than 75% of the fixation points are located within P2, the fixation is classified as "relatively unstable".
  3. If less than 75% are located within P2, the fixation is classified as "unstable".

- Calculating the area of an ellipse which encompasses the cloud of fixation points for a given proportion based on standard deviations of the horizontal and vertical eye positions during the fixation attempt.

The analysis of fixation is performed in every MAIA test independently of the stimuli grid selected.



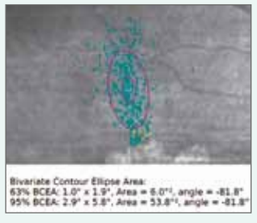




Image of fixation analysis with P1, P2 and the Bivariate Contour Ellipse Area.

## The PRL Training

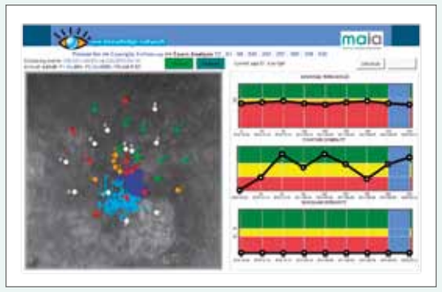
MAIA microperimeter employs auditory and visual bio-feedback signals as eccentric viewing therapy (PRL Training). It is used to train Low Vision patients with central scotoma and unstable fixation, to use a specific retinal location with better functional characteristics. The purpose of the PRL training is to help low vision patients in the better use of residual vision by increasing fixation stability.

# The MAIA Follow-Up Exam

The MAIA Follow-up exam repeats the baseline test by accurately re-measuring the same anatomical locations. It allows precise functional monitoring, even in cases where the retina morphology has changed due to pathology progression.The time line report shows sensitivity and fixation changes in a differential color grid sensitivity map and a time line graphic.

The color code of the differential grid map is the following:

- Increased sensitivity
- Unchanged sensitivity
- Sensitivity decrease of 2 dB
- Sensitivity decrease of more than 2 dB

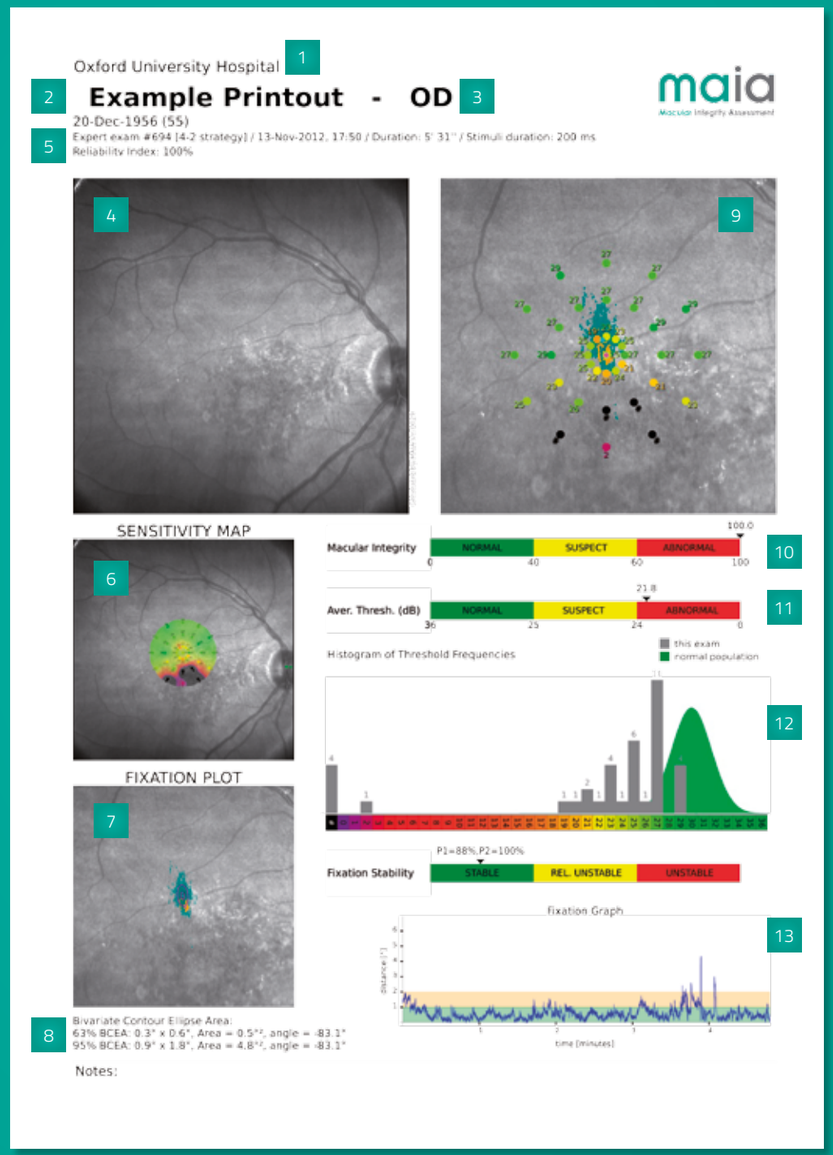


# How to Read Printouts

MAIA contains a reference database for the quantitative comparison of retinal sensitivity to the corresponding normal ranges. MAIA provides a very detailed printout that encompasses all collected information.

## Legend

1. Clinic name
2. Patient info
3. Examined eye
4. SLO image of fundus
5. Exam Info
6. Interpolated sensitivity map over full SLO image
7. Fixation Plot over zoomed SLO image and PRL identification
8. Bivariate Contour Ellipse Area indices
9. Sensitivity values (dB) and PRL over zoomed SLO image
10. Color coded Macular Integrity index
11. Color coded Average Threshold
12. Histogram of Threshold values (grey) compared with normal distribution (green)
13. Fixation graph describing amplitude of eye movements vs. time






maia

Macular Integrity Assessment

maia

Macular Integrity Assessment

## Clinical Cases

MAIA is a perimeter designed to analyse the macular area. There is a wide range of diseases affecting the macula leading to loss of central vision reducing quality of life.

The following clinical cases are collected from a set of retina specialists, who have found in MAIA a useful tool to measure, monitor and rehabilitate central vision in patients with very different retinal pathologies.

# Authors Biography

## Dr. Winfried M. Amoaku

Assoc Professor/Reader in Ophthalmology and Vis Sci, Hon Consultant Ophthalmologist. University of Nottingham UK.

Associate Professor/Reader in Ophthalmology and Visual Sciences, University of Nottingham, and Hon. Consultant Ophthalmologist. Teaching lead for ophthalmology in the undergraduate medical course in University of Nottingham. Consultant Ophthalmologist with a special interest in medical retina diseases (including AMD, RVO, diabetic retinopathy) and uveitis. Dr. Amoaku contributes to cataract services, including provision of surgery, in Nottingham. Other (recent/current) responsibilities:

- Ag President, The Royal College of Ophthalmologists, UK Oct 2010 –May 2011
- Vice President and Chairman, Scientific Committee, The Royal College of Ophthalmologists, UK 2007-2011.
- Chair, The RCOphth Medical Retinal Service Provisions Subcommittee: 2006-2011
- Chair, RCOphth Equality and Diversity Committee 2009-2011
- Member of Scientific, and Examinations Committees 2001-11
- Convener, Elizabeth Thomas Seminar on Macular Diseases, RCOphth: 2003-date
- Member, Scientific Advisory Committee of the Macular Disease Society, UK. 2005-date
- Scientific Reviewer for several journals, SPARC and Wellcome Trust, FFS.
- Editor, Eye News 2005-date

## Dr. Markus Groppe

Academic Clinical Lecturer in Ophthalmology, Nuffield, Oxford University, UK.

Markus Groppe is an Academic Clinical Lecturer at Oxford University. He obtained his medical degree from the University of Münster, Germany. Following this Dr Groppe completed a PhD degree in Ophthalmology at the University of Münster. The thesis focused on the role of nitric oxid in retinal degeneration. He continued his Ophthalmology training in the UK in Birmingham and Oxford and is subspecialising in Medical and Surgical Retina. He is currently Member of Congregation at Oxford University and Honorary Lecturer at the Oxford Eye Hospital and Moorfields Eye Hospital London. His research focuses on treatment of inherited retinal diseases. He is involved in a retinal gene therapy trial for choroideremia and the implantation of retinal implants for restoration of basic vision in blind patients.

## Dr. Samuel N. Markowitz

Director, Low Vision Rehabilitation Program, Department of Ophthalmology and Vision Sciences, University of Toronto.

Associate Professor, Department of Ophthalmology, University of Toronto; Active Staff, University Health Network, Toronto Western Hospital; Director, Vision Rehabilitation Program, Department of Ophthalmology, University of Toronto; Section editor: Low Vision Rehabilitation for the Canadian Journal of Ophthalmology; past member of the Vision Rehabilitation Committee of the American Academy of Ophthalmology. Active practice covering all aspects of low vision rehabilitation including pediatric low vision.

Practicing in a multidisciplinary environment which includes occupation therapy, opticianry and vision rehabilitation specialists for enhancement of independent living skills and orientation and mobility.

Active research interests in various aspects of low vision rehabilitation.

Past and current involvement covered aspects of low vision rehabilitation such as: accessibility and barriers to low vision rehabilitation, characteristics of scotomata and of preferred retinal loci, identification of residual potential visual acuity, rehabilitation with surgical telescopic magnification, and with prisms towards PRL, residual oculomotor characteristics including stereopsis, fixation location and fixation stability, residual chromatic vision, restitution of vision in older children with amblyopia and field expansion in Stroke, Retinitis Pigmentosa and end stage Glaucoma, microperimetry and residual vision functions, interventions to promote brain plasticity and development of indoor navigation systems for the visually impaired.

## Dr. Fabio Mazzolani

Low Vision and Retina Consultant

He specialized in ophthalmology with honors in 2007, carries out diagnosis and treatment of diseases of the posterior segment of the eye (retina and optic nerve) with particular interest in integrating diagnostic morpho-functional and visual rehabilitation. Always interested in the integration of diagnostic imaging and functional diagnostics using microperimetry, he developed different procedures to correlate retinal metabolic features to microperimetry.

The medical and surgical experience is based on specialist training courses and internships carried out abroad and in Italy. He is Consultant at various retinal diagnostic services.

## Marco U. Morales PhDc

Research Fellow,  Academic Ophthalmology. University of Nottingham and Chief Scientific Officer, CenterVue Italy.

Marco graduated from La Salle University in Mexico City in 1991 with a MEng Electronics degree. He has worked in the ophthalmic industry since 1993 as biomedical engineer.

In 2006, he joined a group of scientists and developers of ophthalmic instruments in Italy and since then they have created high-end technologies for retina imaging. He is co-founder of CenterVue Italy and holds a consultant position as Chief Scientific Officer.

In 2012, Marco began his PhD in Ophthalmology and Visual Sciences, at the University of Nottingham. His research involves the analysis of functional changes during the progression of pathologies affecting the central retina and the development of eccentric vision therapies with microperimetry techniques.

## Dr. Stela Vujosevic

Medical Director and R&D Director of the The International Microperimetry Reading Centre, Padova, Italy.

Dr. Vujosevic graduated in Medicine and Surgery at the University of Padova in 2000. Residency in Ophthalmology at the Department of Ophthalmology, University of Padova with final certification for the practice of Ophthalmology in 2004.

Fellowship in Medical retina at the Moorfields Eye Hospital, London in 2004. Fellowship at the Reading Centre, Moorfields Eye Hospital in London in 2004. Contract Researcher at the G.B. Bietti Eye Foundation, IRCCS, Rome 2006-2012. Full time Medical Assistant at the Azienda Ospedaliera di Padova since 2012. PhD at the University of Padova in 2013. Assistant Clinical Professor of Ophthalmology, University of Padova.

Medical Director and R&D Director of the International Microperimetry Reading Centre, certified by the European Vision Institute. Member of the European Reading Centre Expert Committe. Member of the Association for the Research in Vision and Ophthalmology, the EURETINA, the EVER, the European Association For The Study of Diabetes (EASDEC), the Italian Retina Society and the Italian Society of Ophthalmologists.

She currently oversees international research projects and carries out clinical activities concerning screening, morphological and functional instrumental diagnoses, laser and intravitreous treatment of degenerative corioretinal pathologies. She performs cataract surgery and intravitreous injections. She has authored numerous papers published in major international ophthalmological journals

maia

**Macular** Integrity Assessment

adimer.net

maia

Macular Integrity Assessment


| | | | |
|---|---|---|---|
| Centervue SpA | Via San Marco 9H<br>35129 Padova - Italy | Ph: +39 049 7396 147<br>Fax +39 049 7396 148 | info@centervue.com<br>www.centervue.com |
| Centervue Inc. | 92 Bonaventura Drive,<br>San Jose CA 95134 - USA | Ph: +1 408 988 8404<br>Fax: +1 408 716 3271 | infous@centervue.com<br>www.centervue.com |


REV01-130930