

# *BriSCEV* London 2007

## 5<sup>th</sup> National Meeting



*BriSCEV*

British Society for Clinical Electrophysiology of Vision

**Monday 25<sup>th</sup> & Tuesday 26<sup>th</sup> June 2007**

**Kennedy Lecture Theatre,  
UCL Institute of Child Health,  
30 Guilford Street, London WC1N 1EH**



Supported by:



- 10.30** Registration & coffee  
Posters up
- 10.45** BriSCEV Officers Meeting
- 12.00** Buffet lunch  
Clinical case presentations
- 13.15** Welcome
- 13.30** **KEYNOTE LECTURE 1**  
**Professor Tony Moore:** The cone dystrophies
- 14.30** Break
- Oral presentations 1**
- 14.45** **1) Genotypic and phenotypic features of “cone dystrophy with supernormal rod ERG”**  
*Robson AG, Wu H, Cowing JA, Michaelides M, Wilkie SE, Jeffery G, Jenkins SA, Mester V, Bird AC, Moore AT, Hunt DM, Webster AR, Holder GE*
- 15.00** **2) The frequency response of the human short wavelength cone ERG**  
*Hogg C, March A, Neveu MM*
- 15.15** **3) A phenotype-genotype study of enhanced s-cone syndrome**  
*Holder GE, Audo I, Michaelides M, Robson AG, Hawlina M, Vaclavik V, Sandbach JM, Neveu MM, Hogg CR, Hunt DM, Moore AT, Bird AC, Webster AR*
- 15.30** **4) Cursoring the clinical PERG using an expert system trained on real data**  
*Fox M, Fisher AC, Hagan RP, Barber C, Brown MC*
- 15.45** **5) Poster rapid fire**  
11 x 1 minute presentation
- 16.00** Coffee & biscuits & poster discussions
- POSTERS 1st session**
- P1** **Partial cone dysfunction associated with a case of hereditary primary lateral sclerosis: a novel discovery**  
*Thyagarajan S, et al*
- P2** **Partial cone dysfunction – case study**  
*Hardy S, et al*
- P3** **The use of serial wide field multifocal electroretinography in retinitis pigmentosa**  
*McCall A*
- P4** **Is OCT useful for predicting visual function in retinoschisis?**  
*Hayton S, et al*
- P5** **Distinctive and unusual electrophysiology findings in a case of progressive ataxia without dementia**  
*Liasis A et al*
- P6** **The role of electrophysiological testing in patients with acquired ocular syphilis**  
*Wen Y et al*
- P7** **Using event related potentials to study stereopsis in children**  
*Shahani U et al*
- P8** **The optimisation of regression line fitting and the effect of luminance and temporal frequency on sVEP thresholds**  
*Yadav N et al*
- P9** **Examination of unused sequences in multifocal recordings to estimate noise level**  
*Hagan R et al*
- P10** **Review of the ISCEV Calibration Guidelines**  
*Brown M et al*
- P11** **Eighteen month follow up of ocular hypertension with pattern and flash electroretinogram.**  
*North R et al*
- P12** **Intracranial evidence for separation of visual detection and discrimination responses to a change in stimulus orientation in a behaviourally silent paradigm**  
*Flynn M et al*
- 16.45** **AGM**  
BriSCEV membership meeting  
Officers' report  
Election of officers
- 17.45** Drinks reception at ICH
- 18.15** Coach departs ICH for London Eye
- 19.00** Flight on London Eye
- 19.45** Dinner on The Hispaniola Restaurant boat

## Tuesday 26th June

- 8.45 Registration and coffee
- 9.15 **KEYNOTE LECTURE 2**  
**Professor Fred Fitzke:** Recent developments in Optical Imaging in the Eye
- Oral presentations 2**
- 10.15 1) **Advances in OCT & implication for an Electrophysiology Service**  
*Keating D, Dudgeon S, Foulis A, McQuiston A, McCall A, Parks S*
- 10.30 2) **A comparison of retinal nerve fibre layer thickness in patients with and without vigabatrin toxicity**  
*Foulis A, Parks S, Keating D, Shepherd J, Gonzalez P*
- 10.45 3) **The association between multifocal electroretinography and retinal thickness in retinitis pigmentosa patients with normal visual acuity**  
*Wolsey CJ, Silvestri G, O'Neill J, Saunders KJ, Anderson RS*
- 11.00 **POSTERS 2nd session**
- 11.30 4) **To investigate the effects of stimulus field size on the components of the PERG, using a large field plasma monitor**  
*Bradshaw K, Sahare M*
- 11.45 5) **ERG response amplitude change with additional filler-frames between steps of the stimulating M-sequence**  
*Hagan RP, Fisher AC, Brown MC*
- 12.00 **Current Issues & Updates**  
These will include short presentations on latest stem cell research, professional indemnity, white flecks, the visible spectrum & registration with the HPC
- 13.00 Buffet lunch
- 13.45 **KEYNOTE LECTURE 3**  
**Professor Chris Kennard:** Illusions reality and the visual brain
- Oral presentations 3**
- 14.45 1) **A pre-attentive visual discrimination response to a change in orientation in a behaviourally silent paradigm**  
*Flynn M, Liasis A, Gardner M, Towell T*
- 15.00 2) **Concentric ring motion visual evoked potentials (MVEPs) in amblyopia**  
*Nichol DS, McCulloch DL, Manahilov V, Shahani U*
- 15.15 Break
- 15.30 3) **VEP assessment of chiasm formation and blood vessel architecture in foveal hypoplasia**  
*Neveu MM, Sloper JJ, Jeffery G, Holder GE*
- 15.45 4) **Measuring visual function in optic pathway glioma**  
*Dev Boran A, Thompson DA, Hargraves D, Liasis A, Hayton S, Leitch RJ I*
- 16.00 5) **Transient and steady state VEPs in healthy newborn infants**  
*McCulloch DL, Pieh C, Bradnam MS, Boulton R, Bach M, Mactier H*
- 16.15 **Meeting ends**



# Oral Presentations

# Session 1

# Genotypic and phenotypic features of “cone dystrophy with supernormal rod ERG”

Robson AG<sup>1</sup>, Wu H, Cowing JA, Michaelides M, Wilkie SE, Jeffery G<sup>2,1</sup>, Jenkins SA, Mester V, Bird AC, Moore AT, Hunt DM, Webster AR, Holder GE

<sup>1</sup>Moorfields Eye Hospital, London. <sup>2</sup>Institute of Ophthalmology, London

## Aim:

To characterise the range of clinical and ERG features in genetically confirmed cases of “cone dystrophy with supernormal rod ERG”.

## Methods:

Ten patients aged between 10 and 59 years of age were ascertained using ISCEV-standard pattern and full-field ERGs. One patient was tested with peri-orbital recording electrodes. Ophthalmic assessment included fundus photography and autofluorescence imaging (AF). All patients were screened for mutations in *KCNV2*.

## Results:

All patients had reduced visual acuity, photophobia and myopia. Nyctalopia and nystagmus were reported in some cases. Fundi appeared normal in some cases, and in others showed RPE atrophy at the central macula. AF imaging revealed rings of high density that in some cases surrounded central atrophy. Pattern ERGs were undetectable. Dark-adapted ERGs to the dimmest flash were undetectable. Increasing stimulus intensity (ISCEV dim flash) produced an abrupt increase in amplitude and a delayed rod ERG. At higher flash strengths the a-wave commenced normally and in some cases was mildly subnormal. All cases developed a broadened a-wave before a sharply rising b-wave. The b:a ratio varied from 1.6 to 2.7. Photopic flicker ERGs show delay and marked reduction and deteriorated in one individual monitored over 2 years. Characteristic ERG changes were detectable in one patient tested with peri-orbital surface electrodes. All patients tested positive for mutations in *KCNV2*, which encodes a voltage-gated potassium channel subunit. In-situ hybridisation of human posterior retina showed mRNA to be present in photoreceptor inner segments.

## Conclusions:

Patients with “cone dystrophy and supernormal rod ERG” show wide phenotypic variability. Full-field ERG abnormalities are pathognomonic and may be identified with peri-orbital electrodes. The gene responsible may be expressed in both cones and rods.

# The frequency response of the human short wavelength cone ERG

Hogg C, March A, Neveu MM

*Moorfields Eye Hospital, London, UK*

## **Purpose:**

To investigate the spectral and temporal frequency response of the human s-cone ERG, and to optimise the recording parameters used in clinical practice.

## **Methods:**

The temporal frequency response curves of the s-cone ERG were recorded at a range of intensities using a number of different wavelengths of blue light in normal subjects.

## **Results:**

The temporal frequency response of the s-cone ERG exceeds that of the rod ERG, and exhibits a tuned response curve indicating an apparent resonant frequency.

## **Conclusions:**

The stimulus parameters used to optimise the extraction of the s-cone ERG require careful selection in order to enhance the isolation of the s-cone response from that of any light adapted rod contribution.

# A phenotype-genotype study of enhanced s-cone syndrome

Holder GE, Audo I, Michaelides M, Robson AG, Hawlina M, Vaclavik V, Sandbach JM, Neveu MM, Hogg CR, Hunt DM, Moore AT, Bird AC, Webster AR

*Moorfields Eye Hospital, London*

## **Purpose:**

To characterize the clinical, psychophysical and electrophysiological phenotype of 19 patients with Enhanced S-cone syndrome (ESCS) and relate the phenotype to the underlying genetic mutation.

## **Methods:**

Patients underwent ophthalmologic examination and functional testing including Pattern ERG, full-field ERG, long duration and short wavelength stimulation. Further tests were performed in some patients including colour contrast sensitivity (CCS), multifocal ERG, fundus autofluorescence imaging (FAI), optical coherence tomography (OCT) and fundus fluorescein angiography (FFA). Mutational screening of NR2E3 was undertaken in 13 patients.

## **Results:**

The fundus appearance was variable, from normal to typical nummular pigment clumping at the level of the retinal pigment epithelium in older patients. Nine patients had foveal schisis and one had peripheral schisis. Pattern ERG was abnormal in all patients. In all patients, ISCEV Standard photopic and scotopic responses had a similar waveform, the rod-specific-ERG was undetectable and the 30Hz-flicker ERG was markedly delayed with an amplitude lower than the photopic a-wave.

Most ERG responses arose from short wavelength sensitive mechanisms, and a majority of patients showed possible OFF related activity. Multifocal ERG showed relative preservation of central function, but reduced responses with increased eccentricity. Mutations were identified in NR2E3 in 12/13 patients including 4 novel variants.

## **Conclusions:**

The phenotype in ESCS is variable, both in fundus appearance and in the severity of the electrophysiological abnormalities. The ERGs are dominated by short wavelength sensitive mechanisms. The presence, in the majority of patients, of possible OFF-related ERG activity is a finding not usually associated with S-cones.

# Cursoring the clinical PERG using an expert system trained on 'real' data

Fox M, Fisher AC\*, Hagan RP\*, Barber C, Brown MC\*

*Dept. Medical Physics, Queen's Medical Centre, Nottingham, UK*

*\*Dept. Clinical Engineering, Royal Liverpool Univ. Hospital, Liverpool, UK*

## **Introduction:**

The Liverpool Smart Positioning of Cursors (SPoC) web implementation (see [www.liverpooleye.org](http://www.liverpooleye.org)) demonstrates the potential of an Expert (Machine) System approach to automatically place cursors at the 3 cardinal positions (N35, P50 and N95) of a transient PERG recording. In single-blind trials, the Machine Expert significantly out-performed a panel of human experts in a series of random noise contaminated artificial PERG records (morphologically-perturbed versions of the Standard ISCEV PERG Waveform and a selection of clinically-normal PERGs). However, no validation against pathological data was possible, there being no unequivocal reference data available.

In this present work we present a modified version of SPoC, which is trained and validated with normal and pathological clinical data.

## **Purpose:**

To design, construct and validate an Expert System for the automatic cursoring of clinical PERG waveforms without primary recourse to synthetic data.

## **Method:**

33 mixed normal and pathological PERGs recordings were made to the ISCEV Standard using a BioLogic Evoked Potentials system. A panel of 10 human experts placed cursors at cardinal positions on PERGs displayed using undeclared arbitrary units. The inter-observer agreement for each cardinal point was assessed by intraclass correlation and by variance. An Expert System was constructed along the lines of the original SPoC but used clinical data for both training and internal validation. The output target space was constructed as median estimates from the human experts. However, initially, only latencies were derived: post hoc, polynomial fitting was used to infer the N35-P50 and P50-N95 relative amplitudes.

## **Results:**

The spread on the cursor positions reported by the human experts was reflected by low intraclass correlation coefficients and high coefficients of variation (CofVar). In test sets re-using training data, the level of agreement between the Expert System and median values of estimates by human experts was on average >3x better (as CofVar).

## **Conclusion:**

Expert Systems for automatic placement of PERG cursors on clinical data can perform usefully, particularly in noise. The use of median values derived from a panel of human experts can be used as targets in training and allows for some degree of validation. The requirement for a series of reference normal and pathological data remains if this present approach is to be developed further.

A real-time demonstration of the training of the Expert System will be given and its performance illustrated on previously unseen data. All program code will be made available as an Internet-based Open Source website.



# Oral Presentations

## **Session 2**

# Advances in OCT & implication for an Electrophysiology Service

Keating D, Dudgeon S, Foulis A, McQuiston A, McCall A, Parks S

*Tennent Institute of Ophthalmology, Glasgow*

## **Purpose:**

To compare the merits of structural and functional imaging for the clinical diagnosis of retinal disorders.

## **Methods:**

In recent years there have been significant advances in both clinical electrophysiology and in high resolution structural imaging of the retina. In particular, Multifocal ERG has added a new dimension to electrophysiology providing both spatial and temporal information on retinal processing. Significant advance have also been made in imaging retinal structure namely Optical Coherence Tomography (OCT). Structural imaging has always complemented functional techniques but the recent advances in high resolution OCT brings a new challenge to our society. Over the past ten years, we have worked with both structural and functional imaging and recently integrated both techniques in a single instrument (Multimodal Imaging or MMI). We now have an extensive database in which both technologies have been applied in a wide variety of conditions. This presentation is a retrospective look at retinal disorders illustrating the role of both functional and structural techniques and their complementary and sometimes conflicting information.

## **Results:**

New generation OCT machines enable direct high resolution visualisation of retinal structures. In particular, clinical instruments now have axial resolutions of  $< 3 \mu\text{m}$  and can resolve the photoreceptor inner-outer segment junction layer. Research systems now incorporate adaptive optics enabling resolution of individual photoreceptors. Specific examples will be shown to illustrate where OCT can provide the key clinical information without the need for electrophysiology. Contrary to this, examples will be shown where electrophysiology detects abnormalities not seen as structural defects and finally examples where electrophysiology shows function to be more extensively affected than the structural abnormality.

## **Conclusions:**

A key role for our society is promoting electrodiagnostic techniques for diagnosis of clinical disorders. We have never used electrophysiology in isolation but as a complementary technique to standard clinical procedures (FFA, fundus imaging, perimetry etc). However, the advances in OCT are now so significant that clinicians may be less willing to refer for electrophysiology. Our concerns are that we should embrace this technology or risk a serious impact on our society with the emergence of new imaging societies

# A comparison of retinal nerve fibre layer thickness in patients with and without vigabatrin toxicity

Foulis A, Parks S, Keating D, Shepherd J, Gonzalez P

*Tennent Institute of Ophthalmology, Glasgow, UK*

## **Purpose:**

To determine if either the overall thickness of the retina or the retinal nerve fibre layer (RNFL) thickness can be used as a quick and non invasive method for identifying patients with Vigabatrin induced retinal toxicity.

## **Method:**

24 people who have been exposed to Vigabatrin were included in this study, each of whom have been categorised into one of two groups. Group 1 comprised those who have retinal toxicity while group 2 consisted of those who show no evidence of visual field defects. Ten healthy individuals formed group 3. Perimetry (Full Field-120 Screening 3 Zone, Humphrey Field Analyser) was carried out on each person to identify the presence of any visual field defects. A number of patients had difficulties with this test therefore all participants in groups 1 and 2 underwent wide-field multifocal electroretinography (WF-mfERG) to objectively assess retinal function. Finally, the thickness of the nerve fibre and the full thickness of the retina were measured for each person using an OCT Ophthalmoscope (OCT/SLO; OTI, Toronto, Canada). Three measurements were taken and averaged in each case.

## **Results:**

Analysis of the mfERG and the perimetry identified toxicity in 15 of the 24 patients currently taking, or having previously taken Vigabatrin. None of those in group 3 presented with visual field defects. The average RNFL thickness for the 15 patients in group 1 was  $103\mu\text{m}$  with a standard deviation of  $22\mu\text{m}$ . The group 2 average was  $111\pm 20\mu\text{m}$  while for group 3 it was  $126\pm 8\mu\text{m}$ . When comparing groups 1 and 2, it was found that there was no statistical difference between them ( $p > 0.05$ ). However, when groups 1 and 2 were compared in turn with group 3, it was found that the difference in thickness of the nerve fibre was significant in each case ( $p < 0.005$ ,  $p < 0.05$  respectively). The average retina thickness for groups 1, 2 and 3 was  $264\pm 45\mu\text{m}$ ,  $279\pm 24\mu\text{m}$  and  $342\pm 42\mu\text{m}$  respectively. The difference between groups 1 and 2 is statistically insignificant ( $p < 0.05$ ) while the thinning of the retina seen in both groups 1 and 2 when compared with group 3 is significant ( $p < 0.0005$  and  $p = 0.001$  respectively).

## **Conclusion:**

It was found that the retina is significantly thicker in healthy individuals than in those who have been exposed to Vigabatrin but there is no observable difference when comparing those with and without visual field defects. The same conclusions can be drawn from the measurements of the nerve fibre layer, although the differences are less extreme. As this technique cannot distinguish between patients with and without visual field defects it is not a suitable diagnostic tool. Perimetry and WF-mfERG remain more powerful techniques in the diagnosis of Vigabatrin associated toxicity.

**Funded by** Ovation Pharmacia.

# The association between multifocal electroretinography and retinal thickness in retinitis pigmentosa patients with normal visual acuity

Wolsey C J<sup>1,2</sup>, Silvestri G<sup>3</sup>, O'Neill J<sup>3</sup>, Saunders KJ<sup>1</sup>, Anderson R S<sup>1</sup>

<sup>1</sup>*Vision Science Research Group, University of Ulster, Coleraine, UK*

<sup>2</sup>*Northern Ireland Medical Physics Agency, Royal Victoria Hospital, Belfast, UK*

<sup>3</sup>*Department of Ophthalmology, Centre for Vision Science, Queen's University, Belfast, UK*

## **Purpose:**

To investigate retinal structure-function relationships in patients with Retinitis Pigmentosa (RP), using combined measurements of retinal thickness and multifocal electroretinograms (mfERG).

## **Methods:**

The right eyes of 16 subjects with a clinical diagnosis of RP and 16 visually normal subjects were examined. MfERGs from the central  $\pm 25^\circ$  of the retina were recorded and used to evaluate photopic retinal function. Optical Coherence Tomography (OCT) images from the central  $\pm 20^\circ$  of the retina were used to evaluate retinal thickness. Total retinal thickness (RT) and outer nuclear layer (ONL) thickness were determined from OCT and compared to the amplitude and implicit timings of the mfERG responses depending on retinal eccentricity. Analysis of variance and linear regression analysis were used to evaluate the associations between test results.

## **Results:**

Reduced mfERG amplitude was associated with decreased retinal thickness in patients with RP depending on retinal eccentricity. A significant correlation was found between OCT derived retinal thickness and mfERG amplitude beyond the fovea, but not at the fovea. The correlation was strengthened with increasing retinal eccentricity and by using outer nuclear layer thickness rather than total retinal thickness.

## **Conclusions:**

The combination of mfERG and OCT demonstrates structure-function relationships in RP that may be useful in monitoring progressive change in human retinal degeneration.

## **Acknowledgements:**

Supported by a Northern Ireland Research and Development Office Training Fellowship Award.

# To investigate the effects of stimulus field size on the components of the PERG, using a large field plasma monitor

Bradshaw K<sup>1</sup>, Sahare M<sup>2</sup>

<sup>1</sup> *Medical Physics Royal Victoria Infirmary Newcastle Hospitals NHS Trust*

<sup>2</sup> *Dept of Ophthalmology Royal Victoria infirmary Newcastle Hospitals Trust*

## **Purpose:**

To use the 50 inch plasma monitor to investigate the effects of different field sizes (at a viewing distance of 1 metre) on the p50 and n95 components of the transient Pattern electroretinogram (PERG).

## **Method:**

The plasma monitor is able to deliver a high contrast, high luminance uniform pattern reversal stimulus to ISCEV standards 2006. The monitor was driven by a Cambridge Research Systems VSG visage graphics module capable of generating a wide range of field sizes locked to the stimulus check size. The PERG was acquired using a Nicolet Spirit data averaging acquisition system.

The following parameters were used:

Mean luminance of 40 cd/m<sup>2</sup> at 98% contrast with checks subtending 0.8° at a pattern reversal rate of 4 per second i.e. 2Hz.

Amplifier bandwidth was set between 1 to 100Hz. Six stimulus field sizes were generated at: 13, 15, 20, 24, 34 degrees and the maximum screen height and width. A further recording was also performed at a distance of 0.5metres using 0.8° checks to stimulate the full visual field.

Gold foil electrodes were used to record the binocular PERG.

To prevent amplitude reduction effects due to high contrast adaptation, the study time was kept short, thereby any amplitude effects should be stimulus related.

The amplitudes and peak times of p50 and n95 components were measured (trough of n35 to peak of p50 for p50 amplitude, and peak of p50 to trough of n95 for n95amplitude) for each stimulus field size. A minimum of 150 artifact-free sweeps were collected for each trial and at least two trials were recorded for each stimulus check size to confirm reproducibility.

This study was carried out on 4 normal subjects having good visual acuity and no eye or neurological disease.

## **Results:**

We found that the stimulus field size has a considerable effect on p50 amplitude. There was no effect observed on the implicit time of the responses.

The amplitude of p50 increased significantly, at least doubling, with maximum field size.

The least variation in amplitude was observed in field sizes lying between 15 and 20 degrees.

## **Conclusion:**

Large field size containing proportionally more elements than conventional methods of stimulus delivery has a significant effect on p50 amplitude. The p50 amplitude is greatly increased, compared to that expected when using the ISCEV recommendations.

The study will be extended to observe the contribution to p50 amplitude from eccentric retinal parts, using circular artificial scotomata to remove the central 10 to 15 degree field.

**Acknowledgement:** Mr. Brian Cater, Chief Technologist – Electronics and Computing Medical Physics RVI, for expert technical input.

# ERG response amplitude change with additional filler-frames between steps of the stimulating M-sequence

Hagan RP, Fisher A C. Brown MC

*Dept. of Clinical Engineering, Royal Liverpool Univ. Hospital, Liverpool*

## **Purpose:**

To identify the changes of the ERG recorded to a single flashing hexagon governed by an m-sequence with varying filler frames.

## **Methods:**

There are a number of possible methods to record a multifocal electroretinogram, most of which are underpinned via an m-sequence. The time between flashes is governed by the m-sequence and this time is variable, resulting in differing waveforms (due to non-linearities) being combined to create the first order response. Previous work has suggested ionic and electrical events setup via flash stimulus may take up to several seconds to dissipate. The m-sequence here has been buffered by 0, 1, 2, 4, 7 and 14 filler frames (60Hz) in a cohort of normals. The stimulus is a single 8 degree diameter hexagon.

Recording has been made via the thread electrode. Responses have been recorded to the full m-sequence (n=9), before being exported and cross correlated with the m-sequence in Matlab to determine FOK response and higher order kernels (and slices). Recording time for each filler frame length was kept the same so a SNR per unit time comparison could be made.

## **Results:**

Longer filler periods tended to give larger FOK response, but the SOK peak to peak amplitude was not quite as straightforward, with a slight increase in size between 0 frames and 1 frame and then a decrease with little detected when the stimulus was padded out with more than 4 filler frames.

## **Conclusion:**

The recorded ERG is different for different flash intervals, particularly when the flash interval is less than 5 frames (83ms). A larger FOK response is seen when the m-sequence is slowed down using filler frames with a larger higher frequency contribution.

# Oral Presentations

## **Session 3**

# A pre-attentive visual discrimination response to a change in orientation in a behaviourally silent paradigm

Flynn M<sup>1</sup>, Liasis A<sup>2</sup>, Gardner M<sup>1</sup>, Towell T<sup>1</sup>

<sup>1</sup>Department of Psychology, University of Westminster, London, UK

<sup>2</sup>Department of Ophthalmology, Great Ormond Street Hospital for Children, London, UK

## Background:

Mismatch Negativity (MMN) is a component of an Event Related Potential (ERP) believed to represent a central pre-attentive change detection mechanism. MMN has been extensively studied in the auditory modality and recently there has been interest in identifying an analogous mechanism in the visual modality.

**Purpose:** To elicit Visual Mismatch Negativity (vMMN) to a change in orientation in a behaviourally silent paradigm.

## Methods:

Three stimuli were employed that differed from each other only in terms of orientation of four constituent elements. Elements were randomly rotated for deviant and standard stimuli and formed an illusory Kanizsa figure - to capture spatial attention, for a distractor stimulus. Stimuli were presented to participants in a passive oddball paradigm on a computer screen. Twenty-one silver-silver chloride electrodes (10-20 system) were used to record electrical activity in fourteen participants (10 females) mean age 34.5 years.

## Results:

A positive negative positive complex was recorded to all stimuli. The amplitude of the first major positive component was similar for the standard and deviant stimuli. In contrast, the negative component was larger for deviant compared to standard stimuli. Analysis of grand average waveforms and waveform subtraction methods revealed significant vMMN with a peak latency of around 180ms at occipital electrodes. A P3a over frontal/central electrodes in response to the distractor suggests the illusory figure was able to catch spatial attention and orientate subjects to the recording. Conversely, the absence of P3a to deviant stimuli suggests no attention was drawn to the standard-deviant transition. Source estimation methods revealed that the obligatory components (P1,N1,P2) were localised bilaterally to extrastriate cortex while the vMMN was localised within posterior temporal cortex.

## Conclusions:

In a behaviourally silent oddball paradigm, a vMMN to a change in orientation can be elicited, with a source different to that of the obligatory components. The ability to record a vMMN provides a useful tool to investigate visual memory and may start to bridge the gap between standard clinical pattern Visual Evoked Potential assessment and behavioural performance.

# Concentric ring motion visual evoked potentials (MVEPs) in amblyopia

Nichol DS, McCulloch DL, Manahilov V, Shahani U

*Vision Sciences Department, Glasgow Caledonian University, Glasgow, UK*

## **Purpose:**

Amblyopia affects a range of visual functions; Pattern reversal (PR)VEPs show delayed peak latencies and reduced amplitudes in amblyopic eyes. Although psychophysical investigations have found defects of motion perception in amblyopic subjects these have not been reported using evoked potentials.

## **Methods:**

VEPs were recorded binocularly and monocularly in 11 amblyopic and 15 control subjects, amblyopic subjects had reduced stereopsis and greater than one line (logMAR) reduction in visual acuity Stimuli for MVEPs were concentric rings with expanding or contracting motion (spatial frequency 1cpd, moving at 5°/sec, 10% contrast, 20% duty cycle, 4° central mask and visual field of 21.7°); PRVEPs (2 reversals), pattern onset VEPs (POVEPs) (200ms on/off) using the concentric ring stimuli and ISCEV PRVEPS to a 15' check pattern at four electrode sites OZ, P7, P8 and PZ.

## **Results:**

The MVEPs had a positive component at around 130ms (P1) and a negative component at 160 to 200 ms (N2). These MVEP waveforms differed from those of the PRVEP and POVEPs elicited by concentric ring stimuli, which were broadly similar to the ISCEV standard PRVEP and POVEP waveforms, respectively. Direction of motion made no difference in the MVEP.

MVEP amplitudes were largest at OZ, with the P1 to N2 amplitude being significantly larger. For both amblyopic and control subjects the P1 to N2 amplitudes were larger for binocular presentation than for monocular presentation (by a mean of 1.32X). Differences between amblyopic and control groups were not significant for any of the MVEPs

Amplitudes of the ISCEV PRVEP were reduced in amblyopic eyes compared with those of fellow and control eyes but peak latencies did not differ significantly. There was no significant difference in the MVEP P1 peak latency between the amblyopic and control subject groups this agrees with our finding that there were no differences in ISCEV PRVEP peak latencies

## **Conclusion:**

We conclude that MVEPs are preserved in amblyopia although PRVEPs are reduced

# VEP assessment of chiasm formation and blood vessel architecture in foveal hypoplasia

Neveu MM<sup>1,2</sup>, Sloper JJ<sup>2</sup>, Jeffery G<sup>1</sup>, Holder GE<sup>2</sup>

<sup>1</sup>Institute of Ophthalmology, UCL, UK, <sup>2</sup>Moorfields Eye Hospital, UK

## Purpose:

A failure of human foveal development occurs in 2 genetically determined disorders; aniridia (PAX6 mutation) and albinism (tyrosinase mutation). The chiasmatic pathways and retinal blood vessel patterns are disrupted in albinism. It is assumed that these three abnormalities have a common mechanism. Here we investigate whether similar abnormalities are present in subjects with aniridia.

## Methods:

Three subject groups were studied; 10 normal (24-47 years), 10 albino (16-57 years) and 5 aniridic subjects (22-56 years). Fundus photography was performed on all subjects. The superior and inferior temporal retinal arteries were analysed in terms of exit angle from optic nerve head (°) and degree of asymmetry across the horizontal meridian (Asymmetry Index, AI). Visual evoked potentials (VEPs) to flash (FVEP) and pattern appearance stimulation (PappVEP) were recorded in all subjects. The amplitude and latency of the P2 and CI components were analysed.

## Results:

**Blood vessel architecture:** The fundi in normal subjects were normally pigmented. The main arteries entered the globe at an angle,  $=66\pm 11$  degrees and had an symmetrical arching pattern around the foveal region (AI=0.86±0.10). In 6/10 subjects a cilio-retinal artery was present. The fundi in albino subjects were hypopigmented and choroidal vessels were clearly visible. No darkened foveal region could be identified. The exit angle,  $=92\pm 8$  degrees, was significantly greater than in normal subjects ( $P<0.005$ ) and the arcing pattern was asymmetrical compared to normal subjects (AI=0.72±0.13,  $P<0.05$ ). In 6/10 subjects, an additional arterial vessel, that appeared to originate from the central retinal artery (i.e. not a cilio-retinal artery), coursed through the presumptive foveal region towards temporal retina. The fundi in aniridic subjects were normally pigmented. No darkened foveal region could be identified. The exit angle varied considerably between subjects and was not significantly different from normal ( $=72\pm 23$  degrees,  $P>0.1$ ). The arching pattern was different to that seen in normal and albino subjects, and the degree of asymmetry was greater (AI=0.64±0.15). An additional arterial vessel, coursing through the presumptive foveal region, was seen in 3/5 subjects.

**VEPs:** FVEPs and PappVEPs recorded in normal subjects showed no significant inter-hemispheric amplitude or latency difference ( $P>0.5$ ). FVEPs and/or PappVEPs in albino subjects showed a significant inter-hemispheric amplitude or latency difference ( $P<0.001$ ), which was significantly different from normal and aniridic subjects ( $P<0.0001$ ). FVEPs and PappVEPs recorded in aniridic subjects showed no significant inter-hemispheric amplitude or latency difference ( $P>0.5$ ), similar to those seen in normal subjects, and markedly different from those found in albinos.

## Conclusions:

Mutations in Pax6 and Tyrosinase both affect foveal development. However, they have a fundamentally different impact on the formation of the retinal vasculature and the visual pathway projections from this region. This strongly suggests that separate mechanisms regulate the development of the central retina and decussation patterns at the optic chiasm.

# Measuring visual function in optic pathway glioma

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## **Aim:**

To assess the role of visual electrophysiology and standard measures of visual function in the management of young children diagnosed with optic pathway glioma.

## **Methods:**

A retrospective case note review was carried out for 18 children with optic pathway gliomas who had VEPs carried out according to ISCEV paediatric standards at Great Ormond Street Hospital. Pattern reversal, pattern onset and flash VEPs were analysed. Patients' visual acuity (VA), visual fields, colour vision and MRI scan data were collated and considered with visual electrophysiology data.

## **Results:**

Visual electrophysiology was achieved at earlier ages than colour vision and visual fields. Overall, 'good' presenting vision (defined as VA  $\leq$  0.48) was a good prognostic sign irrespective of age.

All patients showed some VEP abnormality, ranging from markedly abnormal to waveform broadening. 6 patients had VA equal to or better than 0.48 in each eye. 6 patients had severe unilateral dysfunction and 6 severe bilateral disease; 4 of the 6 had NF1 and showed unremitting slow deterioration.

The PVEP was abnormal in various ways in patients with 'good' visual acuity.

All patients with field defects had abnormal VEPs. 4 patients had trans-occipital asymmetries suggesting hemi field problems, but only 2 patients managed formal fields - 1 of these 2 yrs after the VEP first indicated a half field defect.

## **Conclusion:**

In young children with known optic pathway glioma, visual electrophysiology can provide unique information and have a role in clinical management.

# Transient and steady state VEPs in healthy newborn infants

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## **Purpose:**

In newborn infants have limited periods of alertness and pattern fixation is difficult to achieve. Thus, clinical VEPs rely on flash stimuli. VEPs to steady-state luminance stimulation (flicker) could be used to assess the temporal properties of the visual system.

## **Methods:**

Subjects were 18 healthy infants born at term (>37 weeks gestation) and tested within 48 hours of birth while asleep (8), awake (8) or tested in both states (2 infants). VEPs were recorded from the occipital scalp to a transient bright flash (25cd.s/m<sup>2</sup>) delivered at 1 Hz and to steady-state flicker at six temporal frequencies ranging from 2.9 to 38Hz (50cd/m<sup>2</sup>, ON/OFF 50% duty cycle). All stimuli had a wide field delivered by a hand-held integrating sphere. Flash VEPs were classified according to the waveform, reproducibility was ranked subjectively from excellent to poor, and amplitude was measured from the largest peak to trough regardless of waveform. Magnitude, SNR and p values for the steady-state VEPs were evaluated at the stimulus frequency (F1) and at its first harmonic (F2).

## **Results:**

All infants had excellent or good transient flash VEPs with no significant differences based on sleep state. All infants also had significant steady-state VEPs to 4.6 Hz flicker at F1, F2 or at both harmonics ( $p < .05$ ). Infants who were awake were more likely to have a detectable F2 (7/10) than those who were sleeping (4/10). Steady state VEPs to higher frequency flicker (7.3 or 12.6 Hz) were detectable in less than half of the infants and none showed VEPs to flicker at 19 Hz or above. For slow flicker at 2.9 Hz, detection was difficult in the presence of low frequency noise.

## **Discussion:**

Neonatal steady-state VEPs show marked immaturity consistent with limited temporal resolution. In the present series, only stimulation at 4.6 Hz reliably elicits VEPs in healthy neonates.

# Poster Presentations

# P1

## **Partial Cone Dysfunction associated with a case of hereditary primary lateral sclerosis: a novel discovery**

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### **Purpose:**

To present two brothers diagnosed with hereditary primary lateral sclerosis who exhibit electrophysiological features of an unusual form of partial cone dystrophy.

### **Methods:**

Two brothers, aged fifteen (px1) and eleven (px2) developed a progressive four-limb mixed spastic/dystonic motor disorder with pseudobulbar palsy in early infancy, and were diagnosed with hereditary Primary Lateral Sclerosis. They underwent GOS and ISCEV standard ERG & VEP testing; modified as necessary to account for postural and muscular difficulties.

### **Results:**

Both siblings' ocular movements, pupil reflexes, anterior segment, fundal examination were normal.

Px1 has mild myopic astigmatism and a left alternating squint, but visual acuities were 6/7.5 and 6/12, and he identified all Ishihara plates correctly. Px2 has astigmatic myopia and was prescribed glasses at the age of five. Best corrected visual acuities are 4/24 and 4/36. The left eye is amblyopic with a left divergent squint. He identified the Ishihara test plate only.

Despite differences in behavioural measures the ERGs of both siblings were similar showing:

Normal rod driven ERGs,

Markedly attenuated 30Hz flicker & loss of scotopic red ERG.

Photopic cone ERGs demonstrated a poorly defined a-wave and delayed (50ms) normal-amplitude b-wave. The ISCEV Ganzfeld cone ERG waveform was similar to scotopic mixed rod cone ERG waveform.

pVEPs were evident to moderate checksizes from px1, but were markedly attenuated for px2.

These ERG findings do not conform typically to those found in other 'cone' conditions such as enhanced S-cone syndrome, incomplete achromatopsia, cone dysfunction with supra-normal rods or blue cone monochromacy.

### **Conclusions:**

These are the first reports of a cone dystrophy presenting in association with primary lateral sclerosis.

# P2

## Partial Cone Dysfunction - case study

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### **Purpose:**

To investigate electrophysiologically a case of atypical partial cone dysfunction

### **Methods:**

A 15 year old male first seen aged 9 years with photophobia, myopia (-4.50/-3.25 x5 RE, -4.50/-4 x1.75 LE) & macula atrophy, but no nystagmus underwent electrophysiological testing. This included GOSH protocol skin ERGs, ISCEV standard ERGs, maximal flash, S-cone ERGs, on-off ERGs, PERGs & PVEPs. Colour vision testing was also performed & OCT images taken.

### **Results:**

GOSH protocol skin ERGs showed well preserved rod driven ERGs and large, but delayed, photopic flash ERG. Pattern reversal VEPs were evident at increased latency to a range of checksizes. Together these results suggest partial cone dysfunction. ISCEV standard ERGs agreed with these findings. S-cone ERGs were preserved but delayed & M cone ERGs reduced.

Colour vision testing demonstrated preserved blue cone function with Berson plates, but a red-green deficit with Ishihara plates. Prolonged on-off ERGs showed reduction of both on & off responses excluding a specific hyperpolarising or depolarising deficit.

OCT topographic maps show bilateral eccentric fixation avoiding 2mm circular region of extended thinning at both maculae.

### **Conclusions:**

These data could represent a phenotypic variant of Stargardt maculopathy with cone dysfunction, but aspects of the ERG waveform better agree with some unusual cases of macula atrophy described in blue cone monochromats e.g Ayyagari et al (1999).

# P3

## The use of serial wide field multifocal electroretinography in retinitis pigmentosa

McCall A, Lam FC, Parks S, Keating D, Hammer H

### **Purpose:**

Goldmann visual fields (VF) are used routinely in monitoring the visual loss in retinitis pigmentosa (RP). The visual outcome can vary widely even between different members of the same family. However, the qualitative nature and inherent variability in the Goldmann VF can cause difficulties for the clinician. We explore the use of serial wide field multifocal electroretinography (mfERG) in monitoring and developing prognostic information of patients with RP.

### **Methods:**

A retrospective analysis of 33 patients with different phenotypic variants of retinitis pigmentosa was undertaken. Follow up ranged from 32 months to 27 years. Assessments included best-corrected snellen visual acuity, slit lamp biomicroscopy and fundus examination, serial Goldmann VFs, Ganzfield electroretinography (ERG) and multifocal electroretinography using a custom built wide field mfERG.

### **Results:**

Age range: 18-80 years (median: 55). Visual acuity at last follow-up ranged from no perception of light to 6/5. Various distinctive patterns and varying severities of visual field constriction were noted on the Goldmann VF. Variability in the Goldmann VF was demonstrated with inconsistent changes in the shape and severity of VF constriction, and clinically unexplainable transient improvements being noted in at least 1 follow-up visit in all 33 patients. The mfERG was able to provide an objective measure of the rate of progression of the loss of retinal function. In 2 patients the mfERGs allowed the earlier diagnosis of RP as the mfERGs demonstrated progressive losses in retinal function despite the ERG and Goldmann VF being normal in the initial years.

### **Conclusions:**

Establishing an exact genetic diagnosis is not always possible. However, the use of serial mfERG can be used to diagnose RP at an earlier stage as the changes precede changes in the Goldmann VF. The mfERG is a more objective test than the Goldmann VF for monitoring the rate of progression RP and serial mfERGs provide more reliable prognostic information for patients. The relationships between the mfERG amplitudes and implicit times, and the Goldmann VFs are however complex and further study is recommended.

## Is OCT useful for predicting visual function in retinoschisis?

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### Introduction:

Retinoschisis is a hereditary condition that causes splitting (schisis) within the inner layers of the retina that leads to visual impairment, especially when splitting affects the fovea. Gene therapy has recovered ERG b-waves in mouse models, but the inter-relationship of structural and functional in man is not well studied.

### Purpose:

To investigate the relationship between macular retinal structure in retinoschisis as seen on OCT and visual function measurements (behavioural acuity and pattern VEPs).

### Methods:

Macula profiles were imaged using Stratus OCT3 (Zeiss) in 10 patients (aged 5-17y, median 12y) with retinoschisis. Central foveal retinal thickness (CFT) and the cumulative area of cystic spaces (CA) within the macula were calculated from the images. The number of tissue bridges/connections within the fovea also investigated.

Pattern reversal (3/s) and/or pattern onset (230ms on, 300ms off) visual evoked potentials (VEPs) were recorded from an array of 3 occipital electrodes referred to Fpz, from each eye to a range of checksizes (400'-25'). Pattern onset and/or flash stimulation were used when no response was elicited to any p.reversal check size. VEP vision was qualitatively graded according to presence of consistent responses to different check sizes. Uniocular visual acuities (VA) were measured using Snellen or logMAR charts. Snellen acuities were converted to logMAR equivalents for ease of comparison and related to the retinal eccentricity expected to support this acuity normally.

### Results:

OCT macula profiles were obtained from 19 eyes: 17 showed the characteristic cystic wheel spoke foveal schisis, 2 eyes showed schisis only in the near periphery. CFT were increased in 14 eyes (median 415um, range 277-493um). Monocular visual acuities ranged from 0.2-1.7 logMAR (median 0.48 logMAR). Monocular p.reversal VEPs to 50' check (lab standard) were normal from 3 eyes. Others (11 eyes) showed a range of broad pattern reversal VEP waveforms (>80ms) and increased peak latencies (median 121ms). 5 eyes had VEPs only to pattern onset and flash stimuli.

There was no correlation between CFT or CA and either VA, PVEP latency or amplitude (100' – 25' checks).

There was also no correlation between number of neural tissue connections within central 1mm of retina and either qualitative or actual VA. When VA was cross-correlated with retinal eccentricity, 11/17 eyes showed neural tissue connection at this eccentricity, but 6 eyes did not.

### Conclusions:

There does not appear to be a structure function correlate in foveal schisis to standard clinical measures VA, pVEP and OCT analysis in retinoschisis. In addition vision is reduced in the absence of foveal schitic lesions and in the presence of normal macula profile suggesting additional functional compromise.

# P5

## Distinctive and unusual electrophysiological findings in a case of progressive ataxia without dementia

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### **Purpose:**

We report unexpected, distinctive electrophysiological findings involving the visual system in a 13-year-old boy with a 7 year history of progressive ataxia and motor impairment, but no visual symptoms. Both generalised and focal seizures occurred at 10-11y, but not in the 12 months before recording. The EEG had shown isolated epileptiform spikes over the occipital region since age 10y

### **Methods:**

A variety of electrophysiological tests were carried out including EEG, SEP's and VEP's.

### **Results:**

EEG revealed epileptiform spikes over the occipital region that followed the frequency of photic stimulation between 1 and 40Hz. These spikes remained confined to the posterior half of the head and maximal at the mid-occipital electrode. Despite the absence of myoclonus, 'giant' somatosensory evoked potentials (N20, P25 and bilateral increased 'C' reflexes), indicated abnormal cortical excitability of the somatomotor system. Muscle biopsy showed a myopathy. SCA1 gene testing and mitochondrial DNA studies were normal.

ERGs were normal. Atypical pattern reversal and offset VEPs were evident to a range of test checks. An early positive component was present for all check sizes. A later broad positivity to small checks became polyphasic to larger test checks. Pattern onset responses were of more typical morphology but occasionally modified by atypical high amplitude time locked activity.

### **Conclusion:**

The apparent involvement of both magno- and parvo-cellular systems and occipital spikes does not seem to have been reported before in this context.

# P6

## The role of electrophysiological testing in patients with acquired ocular syphilis

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### **Purpose:**

To describe electrophysiological changes in 3 patients with acquired ocular syphilis both before the diagnosis of systemic syphilis and following treatment with penicillin.

### **Methods:**

Three patients with a provisional diagnosis of acquired ocular syphilis were referred to us for electrophysiological investigations. Initially serial visual electrophysiological recordings, including pattern reversal VEP, standardised ERG and multifocal ERG (using VERIS 4.7), were performed on all three patients to assess their retinal and optic nerve function. Treatment for neurosyphilis (penicillin) was initiated after the provisional diagnosis was confirmed, and they were referred back to us to monitor progression. Thereafter the pattern reversal VEP and mfERG were repeated 3 or 4 times over 6 or 12 months following the treatment. Both amplitude (peak to trough) and latency of the P100 component of the pattern VEP were measured for all three patients (5 eyes). The first kernel responses of the mfERG were analysed. The amplitude (peak to trough) and latency of the first positive peak (P1) component of the average responses from four concentric rings were measured for each patient.

### **Results:**

Initially, both the pattern reversal VEP and the mfERG were reduced and delayed in all three patients. The standardised ERG was still within the normal limits in some, mildly affected, eyes, but was reduced in other, severely affected, eyes. After the treatment, visual acuity improved significantly (from 1/60 to 6/6) and rapidly within the first 3 months post treatment. The mfERG showed an improvement in P1 amplitude of responses from four concentric rings over the monitoring period. However, the P1 latency did not change significantly.

### **Conclusion:**

Syphilitic ocular manifestations do not show any typical characteristics and early diagnosis with adequate treatment is very important in this serious but treatable condition. This preliminary study shows the VEP and ERG, particularly the mfERG, are very useful not only in establishing diagnosis, but also in monitoring progression during the recovery period.

# P7

## Using event related potentials to study stereopsis in children

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### **Purpose:**

The purpose of our study was to use dynamic random-dot anaglyphic stereograms to follow stereoscopically induced ERPs in normal children and compare these to those of amblyopic adults.

### **Methods:**

Informed consent was obtained from adults and parents of children using local ethical committee guidelines. The stimulus consisted of sine waves (2 cycles per screen) appearing every one-second from a dynamic random red-green dot background and lasted for 500ms. Subjects viewed the stimulus using red green glasses. Electrophysiological recordings were collected using 32 electrodes and a modified template of the international 10/20 system. Electro-oculograms (EOG) were also recorded to monitor blinks (BioSemi Active II). Data were analysed offline using MATLAB.

### **Results:**

Preliminary data from children (aged 5 to 9 years old) with normal binocular vision indicated that latencies of N1, N2 and P3 components of the ERP appeared earlier than they did in normal adults. However, Morlet waveform analysis showed induced temporal frequencies between 40 and 60Hz over temporal and parietal locations after stimulus offset which was different from that found in normal adults. Evoked time-frequency spectra showed a similar pattern.

In amblyopic subjects, N1 peak amplitude was greater for the strabismic than the anisometropes whereas this was reversed for N2 over POz and Pz. The anisometropes showed a significantly delayed N2 at POz relative to the strabismic. Morlet waveform analysis of amblyopic data showed a random distribution of induced temporal frequencies between 40 to 60 Hz that were not time locked to the triggered stimulus.

### **Conclusion:**

Dynamic random dot stereograms may prove to be a useful objective way of assessing the development of stereopsis.

# P8

## The optimisation of regression line fitting and the effect of luminance and temporal frequency on sVEP thresholds

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### **Purpose:**

Knowledge about visual development in humans is very important, as the basis of treatment of many visual disorders such as strabismus or amblyopia depends critically upon understanding the normal process of visual development. Because young children have short attention spans, sweep Visually Evoked Potentials (sVEP) were developed to measure visual response quickly. SVEP measures the brain's visual cortex response by electronically sweeping spatial frequencies or contrast over a particular range in a few seconds. The threshold is usually determined by fitting a regression line and determining the x-axis intercept. Few studies have systematically studied sVEP parameters. The primary purpose of this study is to standardize and optimize the parameters of sVEP.

### **Methods:**

Power Diva software (Smith-Kettlewell Eye Research Institute) was used to generate the grating stimulus and to analyse the results. Three adult subjects with corrected to normal visual acuity and no history of ocular disease took part. Both visual acuity and contrast sensitivity for 1 and 8 cycles per degree were assessed, using sinusoidal grating patterns. The following criteria for regression line fitting were compared; fitting the regression line by eye, using the Power Diva output and fitting the regression line between the signal peak and the final data point with a signal to noise ratio  $\geq 1$ . These were assessed by comparison with psychophysical thresholds and consideration of repeatability (10 repeated sessions). The following parameters of sVEP were investigated; 1. the effect of luminance (25 cd/m<sup>2</sup>, 50 cd/m<sup>2</sup>, 100 cd/m<sup>2</sup>) 2. the effect of temporal frequency (6 Hz, 7.5 Hz, 10 Hz).

### **Results:**

Fitting the regression line by eye or using the Power Diva output gave poorer visual acuity, lower contrast sensitivity and poorer repeatability. Fitting the regression line between signal peak and the data point having signal to noise ratios  $\geq 1$  gave better visual acuity, higher contrast sensitivity and better repeatability. The following values gave optimum responses; luminance of 50 cd/m<sup>2</sup>; temporal Frequency of 7.5Hz .

### **Conclusion:**

The sVEP parameters chosen do have a significant impact on the results. The sVEP parameters found in this study are recommended for future studies.

# P9

## Examination of unused sequences in multifocal recordings to estimate noise level

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### **Introduction:**

In multifocal recording, only a few of the available binary sequences from the master m-sequence are used for stimulation. Other sequences should produce only noise, except where they decode for higher order Kernels of the stimulating sequences. In principle, the signal-to-noise ratio (SNR) of the recording can be estimated by reference to this noise.

### **Methods:**

We examined the noise level distributed across the remaining ('unused') 492 sequences from a 511 ( $2^9 - 1$  sequence) when 19 were used to drive the stimulator. These unused sequences were cross-correlated with the continuous ERG signal to determine apparent noise levels.

### **Results:**

The recovered noise from the unused/unrelated sequences was significantly variable. The pattern of its distribution is not intuitively clear.

### **Conclusions:**

The choice of the background noise reference is not straight-forward. No single unused sequence appears to provide a complete noise model.

# P10

## Review of the ISCEV Calibration Guidelines

**Brown M, Fisher A, Hagan R**

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The ISCEV calibration Guidelines are being reviewed this year. The guidelines were first published in 1998 and revised in 2003.

The current guidelines provide an excellent tutorial in photometry and amplifier characteristics, and go on to propose test protocols for flash and background luminance and pattern luminances and contrast.

Since these earlier guidelines were produced there have been technical developments in stimulus generation which complicate the requirements somewhat, including:

1. Use of Light Emitting Diodes in the generation of flash and light background stimuli. The performance of these differs considerably from the earlier Xenon flash and tungsten background in both spectral content, and in the case of the flash, the waveform and duration. Measurement of flash and background using standard photometric methods may not fully describe the characteristics of these stimuli, implying equivalence when in fact there are major differences.
2. Pattern stimuli using backlit LCD panels, video projectors, plasma, TFT and other generators for pattern stimuli are now common, and CRT displays are soon likely to disappear from the market. These newer devices all work in different ways and provide stimuli which can be fundamentally different from CRT devices. For instance, most of these devices provide continuous light output during each video frame, so that sequential flashes are changed to a continuous light. The continuous nature of the stimulus has implications for calibration of mfERG systems where the same integrated stimulus intensity is recorded for a longer dimmer flash as for the short bright stimulus of the CRT.

In this presentation, these and other issues are explored, including how prescriptive the ISCEV guidelines should be.

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# P11

## **Eighteen month follow up of ocular hypertension with pattern and flash electroretinogram**

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### **Purpose:**

The identification of techniques able to predict progression from ocular hypertension (OHT) to glaucoma is highly desirable. The pattern electroretinogram (PERG) has been utilized in studies of OHT, but recently a component of the flash ERG, the Photopic Negative Response (PhNR), has been found to be sensitive in glaucoma. This study investigates whether the PhNR can predict progression from OHT to glaucoma and compares this with the predictive ability of the PERG.

### **Methods:**

27 OHTs recruited from the University Hospital of Wales, Cardiff consented to participate in the study. Subjects underwent the following investigations at the baseline visit: intraocular pressure (OBF tomometer); visual fields (Humphrey, SITA Standard 24-2); electroretinography consisting of transient PERG, LM-cone ERG and "silent substitution" S-cone ERG. One eye was selected (usually the eye with higher IOP) for electrophysiology. All subjects were invited to return for a follow-up visit after 18 months, where in addition to the tests performed at baseline, simultaneous stereoscopic photographs (Nidek 3Dx) and scanning laser ophthalmoscopy (Heidelberg Retinal Tomograph - HRT II) were obtained. Results were compared with those of a healthy age-matched control group.

### **Results:**

15 OHTs returned for the follow-up visit at 18 months. The number of subjects who converted from OHT to POAG ranged between 20-33%, depending on the classification criteria; four eyes were diagnosed as glaucomatous by stereophotograph analysis and four eyes as "borderline" or "outside normal limits" by Moorfields classification on the HRT II; three eyes had both abnormal stereophotos and HRT results. There was no significant difference in either LM-cone or S-cone ERG PhNR amplitude between the control and OHT groups at either baseline or follow-up visits. The P50-N95 amplitude of the PERG was significantly reduced at the 18 month follow-up in the OHT, but was not significant at baseline. No OHT P50-N95 amplitudes fell outside the normal range at baseline, however two fell below the normal range at follow-up (one with abnormal stereophotos and HRT II, the other with abnormal HRT II only). One subject fell below the normal range for LM-cone PhNR range at baseline and two others additionally at the follow-up visit; one subject had abnormal HRT II at the follow-up and this subject had normal ERG amplitude at baseline. S-cone PhNR data was within the normal range at both visits.

### **Discussion:**

Overall, in this group of OHTs, retinal function as determined by ERG was largely normal, despite a relatively high conversion rate from OHT or POAG over the 18 month follow-up period. These data do not suggest that the ERGs employed in this study cannot accurately predict the progression from glaucoma to POAG and that the PERG appears to provide the best indication of early retinal damage resulting from progression to POAG.

# **Intracranial evidence for separation of visual detection and discrimination responses to a change in stimulus orientation in a behaviourally silent paradigm**

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## **Purpose:**

Mismatch Negativity (MMN) is a component of an Event Related Potential (ERP) believed to represent a central pre-attentive change detection mechanism. The aim was to dissociate detection and discrimination components of the Visual Mismatch Negativity (vMMN) to a change in orientation in a behaviourally silent paradigm.

## **Methods:**

Three stimuli were employed that differed from each other only in terms of orientation of four elements. Elements were randomly rotated for deviant and standard stimuli forming a Kanizsa figure for distractor stimuli. Stimuli were presented in a passive oddball paradigm on a computer screen to a 15 year old male with focal epilepsy undergoing presurgical evaluation for resection of a R anterior parietal lesion. The 32-contact subdural grid straddled the parietal and pre-motor gyri while a 6-contact strip extended posteriorly over the inferior parietal cortex such that the most distal contact (SAO1) overlay the R occipital cortex.

## **Results:**

A negative positive negative complex was recorded to all stimuli. The amplitude of the first major negative component was similar for the standard and deviant stimuli while the positive component was larger for deviant compared to standard stimuli. Responses to stimulus detection (N1) were recorded maximally at the most posterior contact whilst those to stimulus discrimination (vMMN) were recorded more anteriorly. Later positive responses to the distractor stimulus was found at over pre-motor regions, suggesting activation of a frontal system to stimulus novelty and/or target detection.

## **Conclusion:**

In a behaviourally silent oddball paradigm, a vMMN to a change in orientation can be elicited, with a source different to that of the obligatory components. The ability to record a vMMN provides a useful tool to investigate visual memory and may start to bridge the gap between standard clinical pattern Visual Evoked Potential assessment and behavioural performance.

## Monday 25<sup>th</sup> June

- 10.30 Registration & coffee
- 10.45 BriSCEV Officers' Meeting
- 12.00 Lunch
- 13.15 Welcome & Keynote Lecture
- 14.30 Break
- 14.45 Oral presentations
- 16.00 Break & Poster session
- 16.45 AGM
- 17.45 Drinks reception at ICH
- 18.15 Coach departs ICH for London Eye
- 19.00 Flight on London Eye
- 19.45 Dinner on The Hispaniola Restaurant boat

## Tuesday 26<sup>th</sup> June

- 8.45 Registration and coffee
- 9.15 Keynote Lecture & Oral presentations
- 11.00 Break & Poster session
- 11.30 Oral presentations
- 13.00 Lunch
- 13.45 Keynote Lecture & Oral presentations
- 15.15 Break
- 15.30 Oral presentations
- 16.15 Meeting ends

### Organising committee

**Great Ormond Street Hospital  
for Children NHS Trust**  
Dorothy Thompson  
Alki Liasis  
Sharon Hardy  
Sam Hayton

**Moorfields Eye Hospital  
NHS Foundation Trust**  
Chris Hogg  
Graham Holder  
Tony Robson