Do clinical records tell us what optometrists do?

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**Background:** In civil litigation and disciplinary cases, optometric care is typically judged on the basis of clinical records. We found no previous research assessing how accurately optometric records specify the content of optometric eye care. A review found standardised patient (SP) methodology to be the gold standard method for evaluating clinical care (Shah et al., 2007). SPs are actors who are trained to simulate patients and to report accurately on the content of clinical consultations. This approach was used to investigate the content of optometric eye care for three different patient scenarios (Shah et al., 2008; 2009a,b), and in this presentation these data are compared with clinical records.

**Methods:** A total of 102 consenting community optometrists were visited by three unannounced actors for eye examinations. The actors received extensive training to enable accurate reporting of the content of the eye examinations, via an audio recording and a checklist. Upon completion of the SP visits, copies of the clinical records were requested (available in 30–40 cases). Using the SP findings as the gold standard, the information gathered from the clinical record was classified for each item as true positive (reported by SP and documented), false positive (not reported by SP but recorded in the records), false negative (reported by SP but not documented), false positive (not reported by SP but recorded in the records) and true negative (not reported by SP and not documented).

**Results:** Compared to the gold standard, false positives were identified during record abstraction in 4% and false negatives in 18% of eye examination components. For symptoms and history, the proportion of false negatives ranged from 15 to 24% and 3–4% for false positives. The proportion of false negatives for tests performed during the eye examinations ranged from 12 to 22% and false positives from 2 to 6%. Optometrists give patients more verbal advice than is indicated in their records (false negatives, 11–19%). On average, 5% of practitioners recorded patient management and advice that was not reported by the SPs.

**Conclusions:** Clinical records are subject to a recording bias leading to both under- and over-estimation of the care provided; most commonly under-recording. These findings have important implications for clinical-legal cases, where clinical records are a key item of evidence. Accurate record-keeping should be a priority for optometric continuing education.

**References**


Acquired colour vision loss in subjects with ARMD and diabetes

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Background: ARMD is the leading cause of irreversible blindness in the developed world in people over 50 years of age and its prevalence increases with age. Conversely, diabetic eye disease is the leading cause of blindness in people under 50 years of age and its prevalence also increases with age. Both conditions affect the metabolic state of the retina, resulting in non-inflammatory damage to retinal structures that lead to retinopathy. These structural changes cause a reduction in chromatic sensitivity and diminished overall visual performance.

Aim: The aim of this study was to quantify and compare the loss of chromatic sensitivity in subjects with ARMD and diabetes.

Methods: ARMD and diabetic subjects with varying degrees of retinopathy were examined. Chromatic sensitivity was assessed using the Colour Assessment and Diagnosis (CAD) test (Rodriguez-Carmona et al., 2005) which isolates the use of colour signals (Barbur et al., 1994) and provides an accurate estimate of both red/green (RG) and yellow/blue (YB) chromatic sensitivity. In addition, data measured in 330 normal trichromats provide the statistical limits to establish when the subject’s colour thresholds fall outside the normal range. Achromatic high contrast acuity and flicker sensitivity were also assessed under both photopic and high mesopic (twilight) viewing conditions.

Results: The results reveal significant loss of RG and YB chromatic sensitivity which in the case of ARMD affects both the central and the peripheral retina and is not localised to the site of retinopathy (the statistical significance of these changes varies from subject to subject with p values < 0.001). Significant loss of equiluminant, rapid flicker sensitivity (p < 0.01) was also observed in all subjects diagnosed with ARMD and diabetes.

Conclusions: The preliminary results obtained so far suggest that the loss of chromatic and flicker sensitivity precedes structural changes in the retina as revealed in conventional fundus imaging. The loss of chromatic sensitivity is therefore a sensitive indicator of early, subclinical damage in subjects with eye disease.

References


Eye movements in glaucoma when viewing everyday scenes

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Introduction: Glaucoma is a group of diseases that cause structural changes in the optic disc and thinning of the retinal nerve fibre layer. Visual function changes start in the peripheral field. Currently little work has been done to investigate the effects on eye movements of loss of visual function. It is unclear if subjects compensate for their loss of vision, and if so how this may occur.

Aims: The aim of this study is to test the hypothesis that patients with bilateral glaucoma exhibit different eye movements compared to normally-sighted subjects when passively viewing computer displayed photographs, or searching for features or items within a scene. This is important as it gives an insight into the point at which glaucoma affects a patient’s ability to perform everyday visual tasks and the effect of visual field defect location.

Methods: Thirty glaucoma patients (Average age: 65.2, SD: 11.0, Humphrey MD RE = -9.18 dB, SD: 5.7; LE MD: -6.47, SD 3.3 dB) and 17 age-matched subjects with normal vision (average age: 70.5, SD: 11.7) viewed 28 randomised digital photographs of various everyday scenes displayed on a computer screen for 3 s each. Subjects were instructed to view the images as they would when looking at a slideshow. The subjects then viewed another set of images, but were timed to find a feature or item in the scene. Eye movements were simultaneously recorded using an EyeLink II (SR Research Ltd, Mississauga, ON, Canada) sampling at 500 Hz. Number of saccades, fixation duration and saccade amplitude in each task were analysed. A novel analysis of the general ‘viewing area’ of the glaucomatous patients was compared to the controls in the passive viewing experiment.

Results: In the passive viewing experiment, there was a significant 6.9% (SD: 0.51%) reduction in the average number of saccades for glaucoma patients compared to controls (p < 0.0001). In addition, average fixation duration was longer and the average area scanned was more restricted in patients. In the search task glaucoma patients took, on average, 9 s (SD: 4.6) longer to find the objects (p < 0.0001). For this task, saccades were still reduced in number but were, on average, slightly larger in amplitude for patients. Scanning patterns appeared related to the type and nature of the binocular visual field defect in some case examples.

Conclusions: These results provide evidence that eye movement behaviour in patients with glaucomatous defects in both eyes differ from normal-sighted subjects when viewing images and photographs. These patients with glaucoma find it more difficult to locate items within scenes compared to normally-sighted subjects.

In vivo imaging of the retinal cone mosaic with a modified Heidelberg Retinal Tomograph

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Purpose: To image the human retinal cone mosaic in vivo and measure cone photoreceptor packing density at different retinal locations using a modified commercially-available scanning laser ophthalmoscope.

Methods: A Heidelberg Retinal Tomograph (HRT1; Heidelberg Engineering, Heidelberg, Germany) was modified to give 2° × 2° high resolution images of the photoreceptor layer in the central retina without adaptive optics in two normal subjects. For each subject, several retinal images were obtained from the parafoveal region out to 8° along the inferior vertical meridian. Individual cone cells were identified manually and used to determine cone density.

Results: The modified HRT device was able to produce reliable images of the cone mosaic structure in each subject at different retinal eccentricities. As expected the density of the cone cells varied with retinal eccentricity, with estimates ranging from 17 000 cells mm⁻² at 0.6 mm from the fovea, to 11 500 at 1 mm, 7000 at 2 mm and 5000 at 3 mm eccentricity.
Conclusions: These images demonstrate the feasibility of measuring in vivo cone photoreceptor packing density using compact technology and without the use of an adaptive optics system. The estimated packing density of the cone photoreceptor cells at different retinal eccentricity compared well with cone counts from histology and adaptive optics imaging. There is a need to more fully explore the potential and clinical utility of the modified HRT to produce quality retinal cone counts in diseases that affect photoreceptor density.

The use of computerised refraction simulators for training optometry undergraduates
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Background: Objective and subjective refraction simulators have been developed for training undergraduates. These include an encrypted code as a check for the validity of results submitted by students using the simulators without supervision. These simulators randomly generate refractive errors and record whether this was neutralised, how many trial lens changes were made and test duration.

Aims and objectives: The simulators used to teach streak retinoscopy and cross cylinder refinement of retinoscopy were evaluated in terms of: (1) the validity of unsupervised use; (2) the relationship between simulator marks and practical assessments; (3) improved performance with repeated use; and (4) student feedback.

Methods: Ninety-five students carried out five unsupervised attempts on both refraction simulators. All repeated attempts at retinoscopy were completed prior to carrying out the same for cross cylinder refinement. The validity of students’ records was checked. Students rated simulators on a 1 (poor) to 5 (good) point scale. A simulator marking scheme was developed which gave 0% if the refractive error was not neutralised or otherwise gave between 40% and 100% according to the number of trial lens changes used and the time taken. Simulator marks were compared to practical refraction assessments. Findings were tested for statistical significance at the 95% level.

Results: Valid results were received from between 60% (for retinoscopy) and 77% (for cross cylinder refinement) of the students. Simulator marks at the last attempt (median ± interquartile range) for retinoscopy (65 ± 28%) and cross-cylinder refinement (75 ± 20%) did not differ from practical assessments (Wilcoxon’s signed rank test) but there was no correlation between simulator marks and practical assessments (Kendall’s correlation). The slopes of regression lines fitted to repeated simulator marks showed that only retinoscopy improved (one-sample t-test, p < 0.001). Over 75% of students submitted feedback. Mean ratings were 4.7 for retinoscopy and 4.6 for cross cylinder refinement.

Discussion: Students rated the simulators highly but the alarming frequency of invalid results and the lack of correlation between simulator performance and practical assessments warrants further investigation into the unsupervised use of simulators for training undergraduate optometrists.

The Northern Ireland Eye Study: prevalence of refractive error

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Background: Although there are geographical differences in the prevalence of myopia (Junghans and Crewther, 2003), levels appear to be increasing throughout the world (Morgan and Rose, 2005). There is a paucity of data describing prevalence of refractive error in the United Kingdom, particularly relating to children. The Northern Ireland Eye Study, along with its sister study, the Aston Eye Study, are the first population-based surveys of children using both random cluster sampling and cycloplegic autorefraction to quantify levels of refractive error in the UK.

Aim: To examine levels of refractive error in childhood, amongst a well defined white UK population.

Methods: Children aged 6–7 years and 12–13 years were recruited from a stratified random sample of primary and post-primary schools representative of the NI population. Participants were tested at school with consent from both the child and their parent/guardian. Measurements of vision, visual acuity, ocular motor balance, biometry, cycloplegic autorefraction, height and weight were taken. Right eye spherical equivalent results were used to define myopia (≤-0.50DS), hyperopia (≥2.00DS) and astigmatism (≥1DC). Anisometropia was defined as an interocular difference ≥1DS. Parents were asked to complete a questionnaire about their child’s environmental and sociodemographic factors. Children aged 12–13 years also completed a questionnaire.

Results: Of those invited, 57% (n = 399) of 6–7-year-olds and 60% (n = 669) of 12–13-year-olds participated. Data are presented for white participants only (99%). Myopia was more prevalent and hyperopia less prevalent at 12–13 compared to 6–7 years. Levels of astigmatism and anisometropia remained stable.

Table 1. The prevalence of refractive error in white schoolchildren in NI (95% confidence intervals)

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Myopia (≤-0.50DS) (%)</th>
<th>Hyperopia (≥2DS) (%)</th>
<th>Astigmatism (≥1DC) (%)</th>
<th>Anisometropia (≥1DS) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6–7</td>
<td>2% (0.5–3.6)</td>
<td>22% (16.1–28.3)</td>
<td>24% (18.7–29.9)</td>
<td>8% (3.9–13.1)</td>
</tr>
<tr>
<td>12–13</td>
<td>15% (10.7–19.3)</td>
<td>12% (8.0–15.6)</td>
<td>20% (14.1–25.3)</td>
<td>9% (5.9–12.9)</td>
</tr>
</tbody>
</table>

Conclusions: This study shows stark differences in the prevalence of myopia from early to late childhood. The prevalence of myopia, hyperopia and astigmatism appear much higher in children in Northern Ireland, compared to studies of white children from elsewhere (Ip et al, 2008a,b; Huynh et al, 2006, 2007). Examining how exposures in early life affect visual development may help to explain the high levels of refractive error observed and will be the topic of future work.

References
Repeatability of a grading system for assessing the recovery movement of the cover-uncover test

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Background: The cover test is one of the most important orthoptic tests and is the only way to distinguish between heterophoria and strabismus. A key task for eyecare practitioners is to differentiate between compensated and decompensated heterophoria, and an assessment of the cover test recovery is the only objective clinical method of assessing compensation. A schema for grading cover test recovery results (Institute of Optometry Cover Test Analysis; IOCTA) is graded 1 (rapid and smooth) to 5 (breaks down readily).

Aims: The purpose of the study is to produce standardised video clips demonstrating the IOCTA grading system and to investigate the repeatability of this system.

Methods: Phase 1: The grading scale was established by video recording classic examples of each of the cover test recovery grades and was used as a grading key. Phase 2: 51 optometrists were sent written instructions on the IOCTA and the grading key video clips on a CD and asked to grade video clips of 20 patients with a clinically detectable exophoria using the IOCTA. Ten of these optometrists re-graded the video clips approximately 6 weeks later. Phase 3: Eight patients with a clinically detectable exophoria were assessed in a real clinical setting by two trained optometrists (the authors) using the IOCTA. The patients returned 1–2 months later for the examiners to repeat the IOCTA.

Results: Phase 2: 95% of the examiners grade within ±2 of the ‘gold standard’ and 80% grade within ±1 of the ‘gold standard’ grade using the IOCTA. The 95% intra-examiner coefficient of reliability was 1.7. Phase 3: 95% inter-examiner limits of repeatability for these examiners for the first examination were -0.42 to +1.05, and on the second examination 95% limits of agreement were -1.24 to 1.81. The 95% intra-examiner limits of agreement for the two examiners in phase 3 were between -1.6 to +1.6 for one practitioner and -0.53 to +0.53 for the other practitioner of the original grade, respectively.

Conclusions: The IOCTA has been shown to achieve a test-retest and inter-examiner repeatability of one grading step in most cases and two grading steps in nearly every case. These data support the use of the IOCTA in clinical practice, possibly as a teaching tool, and in clinical research.

Perception of the world through wobbly eyes – it’s stressing me out!

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Background: Congenital nystagmus is an involuntary, mainly horizontal, movement of the eyes. It is often reported by people with nystagmus that their eye movements and vision become worse when they are stressed. However, this has not been studied. We have therefore been investigating whether stress has an influence on nystagmus and visual performance. The aim of this investigation is to identify the effects of stress on the visual acuity of people with nystagmus. It is believed that stress causes a worsening of eye movements, and a consequent reduction in visual acuity.

Methods: To elicit a state of stress, the threat of a small electrical burst from a transcaneous electrical nerve stimulation (TENS) machine was used. Stress levels were assessed by measuring skin conductance; eye movements were recorded using an infrared limbal eye tracker, and VA was measured using a 2-alternative-forced-choice staircase method. TENS threshold was measured by increasing the intensity one step at a time until the subject stated that they did not want it increased any higher. During measurements where the stressor was used, subjects were told that the intensity of the TENS would be double their threshold. This was never actually done. Each subject had VA measured four times during the investigation:

1. VA measured under relaxed conditions.
2. Task Demand (TD) – Short burst from TENS with incorrect response.
3. (Ant) – Short bursts from TENS at random.
4. VA measured under relaxed conditions (R2).

Results: Eight subjects (four male, four female) were assessed. VA was not significantly reduced during the measurements involving the stressor (Figure 1), even though skin conductance was seen to be higher during these periods (p < 0.05). However, the intensity of the nystagmus waveform was found to be higher during the task demand period (p < 0.05) (Figure 2).

Conclusions: The fact that VA is not significantly affected, even though nystagmus intensity is increased, suggests that there is some visual factor other than VA which may better represent how people with nystagmus see. More research is now needed to investigate what those with nystagmus mean when they say that their vision becomes poorer when stressed, and also what situations result in these feelings.

A survey based investigation into potential barriers to the detection of POAG in UK community optometric practice

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Background: In the United Kingdom (UK), most primary open angle glaucoma (POAG) suspects (>90%) are identified by community optometrists as a result of opportunistic screening of individuals attending for an eye examination. The UK optometric professional body, the College of Optometrists (CoO), has published guidance for its members and recommends three tests to detect the presence of POAG: assessment of the optic nerve head, tonometry and assessment of central visual fields. However, there is the potential for wide variation in case-finding strategies and criteria for referral across the profession. These variations may be due to individual clinical judgement or other external influences. These factors were investigated using a survey of UK community optometrists.

Methods: Optometrists were recruited via email to participate in a purpose-written online survey. The survey questions established respondents’ POAG case-finding strategies. Participants were also invited to comment on any barriers limiting their scope of practise in relation to case-finding and whether routine screening tests were performed selectively because of these barriers.

Results: A total of 2044 responses were received (27.5% of those contacted). The majority of community optometrists reported that they would complete the triad of tests recommended by the CoO, the results of which would be included in any referral letter. Most practices were adequately equipped for glaucoma detection. Equipment typically included a tonometer (78% used a non-contact device), a field screen (39% used a Henson perimeter), and a means of observing the optic disc (62% used a combination of both indirect and direct ophthalmoscopy). Many community optometrists reported barriers to effective detection of POAG in community practice: in particular; remuneration and costs (with notable reference to the GOS eye examination fee structure), time pressures, and lack of suitable or functioning equipment.

Conclusion: The majority of UK optometrists surveyed appear to meet the CoO guidelines for detection of glaucoma. The survey identified barriers to effective POAG case-finding which could limit detection of the disease in the community.

Acknowledgements: The authors would like to acknowledge Pfizer UK Ltd for the unrestricted grant in support of this research, and the Association of Optometrists for assisting with the distribution of the survey.

A survey of cataract direct referral schemes within the London region

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Background and aims: The Department of Health (2000) suggested several ways to help streamline existing cataract services with the aim of providing greater capacity and reducing patient waiting times. One suggested pathway was direct referral from an optometrist into a secondary referral centre. In 2005 the Association of Optometrists listed 37 schemes involving direct referral or ‘Choose & Book.’ Information on the success of these schemes is scant and this study aimed to review the current status of direct cataract referral schemes within the London Region.

Methods: Survey and data collection on cataract direct referral schemes within the London region. Members of Local Optometric Committees (LOCs) were contacted via phone, email or written letter.

Results: In 2007 only three out of 14 LOCs within the London Region currently had a full direct referral scheme running. Seven other LOCs had trialled such schemes. However the pilot scheme was not converted into a full scheme. A lack of funding was cited as the main reason for cessation of the service. The requirement for a Unique Booking Reference Number (UBRN), which, at present, can only be provided by a GP, was also cited as a reason. The past 2 years has seen advances in the provision of direct cataract referral schemes and London now has six fully funded schemes running, and one pilot scheme. Successful schemes share similarities including the requirement for accreditation and a referral fee. Notable differences between schemes include how patients are referred into the service, tests required for initial assessment and the provision of post operative care.

Conclusions: Evidence gathered from audits shows direct cataract referral schemes are successful in effective management of patients with cataracts. Funding is the major contributing factor to the implementation and continuation of these schemes.

Reference


Computerised screening for correctable visual impairment in older people

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Background: In the UK, 20–50% of older people have undetected reduced vision and in most cases this results from correctable problems (refractive error and cataract). Many older people are not availing themselves of state-funded community optometric care.

Objectives: We sought to investigate whether vision screening in the community might (1) educate the public about the need for routine eyecare and (2) provide personalised advice to persuade people with poor vision to seek optometric care.

Methods: We used a computerised vision screening test which was refined after a preliminary study of 180 older people to include tests of: monocular presenting distance high contrast and low contrast visual acuities (VAs), binocular near acuities, and monocular visual fields. We report here the results from this computerised vision screener (CVS) on 200 people aged 65+ (mean age 77 years). 31.5% were seen in community settings including a community day centre; the rest were seen in a primary care optometric practice. All participants were given a full optometric eye examination.

Results: Initially, we defined eye disease as significant gain in monocular distance VA or binocular near VA with new refractive correction, significant cataract, or at risk of rapid progression macular degeneration. The best sensitivity was obtained for a screener test combination of a fail on high contrast VA OR low contrast VA OR near VA (sensitivity 80.3%; 95% CI 74.2 to 86.4; specificity 66.7%; 95% CI 55.6 to 76.1). Alternatively, a screener test combination of high contrast VA OR near VA gave sensitivity of 79.5% (71.5–85.7) and specificity 67.9% (57–77.3). If glaucoma or glaucoma suspects are included in the target diseases, then with a test combination of high contrast VA OR visual field defect, sensitivity of 80.3% can be achieved (72.7–86.2), but specificity drops to 51.5% (39.8–62.9).

Conclusions: Our computerised vision screening does not replace the need for routine eyecare, but may help to educate older people about the need for eyecare and may be useful in detecting people who are not aware of a drop in their VA.

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A pilot study of lighting and low vision in older people
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\textbf{Background:} Some research suggests that increasing lighting levels is helpful for people with age-related macular degeneration (AMD). Cataract causes light scatter inside the eye and additional lighting may therefore impair visual function.

\textbf{Objective:} The purpose of this pilot study was to investigate the influence of lighting on performance at activities of daily living in older people with low vision from cataract and/or AMD.

\textbf{Methods:} We studied 24 people aged over 65 years with visual acuity in the range from 0.21 to 0.60 (logMAR) with cataract (n = 11), AMD (n = 6), or both cataract and AMD (n = 7). Participants carried out four everyday tasks, each at three illumination levels: 50, 200, and 800 lux. The tasks were walking down a slightly uneven corridor, inserting a standard electrical plug in a socket, sorting pills of different sizes, and the Wilkins Rate of Reading Test. Each task was scored for speed and accuracy, but accuracy scores were near perfect in the first three tasks and so were not analysed. Both objective performance and subjective preference were recorded.

\textbf{Results:} The effect of order of testing, which was counterbalanced, was small but reached significance in some groups and tasks. Subjects tended to perform better under brighter conditions, but the average results masked large individual variations. Indeed, most participants showed a large effect of lighting on performance in at least one task, but the optimal lighting level varied idiosyncratically from one subject to another.

\textbf{Conclusions:} Our data do not support generalised statements about the effect of lighting levels in different disease conditions. The best approach to providing optimal lighting for older people with low vision may be to individually assess their preference and performance at different lighting levels. We suggest that the results of this small pilot study warrant a larger study to investigate the individual effect of lighting level in people with visual impairment.

Ocular component contribution to ocular accommodation by vergence analysis
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\textbf{Aim:} To examine ocular component contribution to ocular accommodation in terms of vergence analysis.

\textbf{Methods:} Utilising a recent schematic eye, a step-along reverse ray trace from the retina to the far point was created. The outcome refractive status and vergence contribution of each axial distance and surface radii were subsequently examined. The age of the model was varied between 20 and 50 years, and the accommodation level was modified from 0.0 to 4.0 D in 1.0 D steps. The results were displayed as physical biometric change (mm), vergence change (D) and Vergence Contribution Factor (VCF; D mm\textsuperscript{-1}) for each ocular component.

\textbf{Results:} The model behaves in a similar manner to published data with regard to axial distance and surface radii changes with accommodation. In terms of vergence changes, axial distance variations reduce the output refractive status (+1.8 D for 4.0 D of accommodation; 20-year-old eye), whilst all surface changes enhance (+6.3 D); the primary root for this is the anterior crystalline lens (+3.6 D). Anterior chamber depth and lens thickness alter in contrary directions to a similar magnitude; however, the negative vergence change exhibited by the anterior chamber (-1.2 D) is superior to the lens (-0.2 D). The posterior lens radius has the greatest VCF; it having a superior ability to modify outcome refraction per unit change of accommodation.

\textbf{Conclusion:} Analysing the human eye in terms of physical biometric changes taking place with accommodation provides insufficient information about the accommodative system. Using vergence change, however, highlights the role that each ocular component plays in the overall accommodative output and enhances our understanding of the mechanism of accommodation.

A rapid flip-chart screening tool for reduced vision in older people
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\textbf{Background:} In the UK, 20–50% of older people have undetected reduced vision and in most cases this results from correctable problems (refractive error and cataract). Many older people are not availing themselves of state-funded community optometric care.

\textbf{Objectives:} We sought to investigate whether vision screening in the community might (1) educate the public about the need for routine eyecare and (2) provide personalised advice to persuade people with poor vision to seek optometric care.

\textbf{Methods:} We used a flip-chart vision screening test which was refined after a preliminary study of 180 older people to include tests of: monocular presenting distance high contrast and low contrast visual acuities (VAs) and binocular near VAs. We report here the results from this flip-chart vision screener on 200 people aged 65+ (mean age 77 years). 31.5% were seen in community settings including a community day centre; the rest were seen in a primary care optometric practice. All participants were given a full optometric eye examination.

\textbf{Results:} Initially, we defined eye disease as significant gain in monocular distance VA or binocular near VA with new refractive correction, significant cataract, or at risk of rapid progression of macular degeneration. The best sensitivity was obtained for a screener test combination of a fail on high contrast VA OR low contrast VA OR near VA (sensitivity 82%, 95% CI 74.2–87.8; specificity 61.5%, 95% CI 50.4–71.6). Alternatively, a screener test combination of low contrast VA alone gave sensitivity of 75.4% (67.1–82.2) and specificity 76.9% (66.4–84.9).

\textbf{Conclusions:} This rapid flip-chart vision screener does not replace the need for routine eyecare, but may help to educate older people about the need for eyecare and may be useful in detecting people whose are not aware of a drop in their VA. In particular, this tool might be useful in rehabilitation centres, for example where older people are recovering from falls. The test results should include the caveat that the screening test does not replace the need for regular eye examinations, which are necessary to detect glaucoma.

Regional differences in retinal profiles between emmetropes and myopes
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\textbf{Background:} Previous literature has described two methods of determining retinal contour; peripheral refraction and 2-D magnetic
resonance (MR) imaging. Both have significant limitations. Peripheral refraction is prone to errors due to large measurement angles and 2-D MR imaging relies upon conclusions to be drawn using relatively large MR image slices. The development of 3-D MR imaging in our laboratory allows a more comprehensive depiction of ocular shape not constrained by these factors.

Objectives: To examine the variation in retinal contour between emmetropic and myopic subjects, with particular reference to the superior, inferior, nasal and temporal quadrants.

Methods: Twenty-eight young adult subjects (13 emmetropes, 15 myopes), were scanned using a MagnetomTrio 3 Tesla MRI scanner (Siemens Medical Solutions USA Inc., Malvern, PA, USA). Subsequently 28 T2-weighted images (of the left eye) were examined using a modified version of freeware software, mri3DX (authored by KDS). A 3-D flood-fill algorithm is applied, and shading manipulated manually, in the sagittal, coronal and axial planes. A sphere consisting of approximately 32K triangular polygons thus encapsulates the whole eye and automatic segmentation and meshing algorithms generate a 3-D surface model by an iterative shrink-wrap process such that approximately 8K points depict each quadrant. After accounting for disparities between optical and visual axes (angle alpha), the 3-D data comprising each quadrant were fitted with a 2nd order polynomial to illustrate 2-D retinal surface profiles between approximately 20% and 100% of the axial length.

Results: Comparison of r² coefficients showed significant differences between the two refractive groups primarily for the inferior and nasal quadrants (p < 0.005). In both refractive groups, the superior quadrant was more bulbous than its inferior counterpart (ANOVA: mean difference 0.005 ± 0.03 p < 0.001 in myopes and 0.004 ± 0.03 p < 0.05 in emmetropes). In emmetropes, the temporal quadrant was the least bulbous of all four quadrants (mean difference -0.007 ± 0.003 p < 0.001 for the nasal quadrant; -0.008 ± 0.003, p < 0.001 for the superior, and -0.004 ± 0.003 p < 0.05 for the inferior). No such differences were found in myopes.

Conclusions: Structural asymmetries both between- and within-myopic and emmetropic groups have been identified. Current work is investigating functional corollaries for these asymmetries specifically with regard to mERG.

An evaluation of the introduction of Objective Structured Clinical Examinations (OSCEs) into an undergraduate optometry course

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Background: The Objective Structured Clinical Examination (OSCE) has widespread use in medical education. OSCEs offer robust and defensible methods of assessing clinical skill and competency and lend themselves to methods of standard setting.

Aim: The aim of this work was to improve student learning and clinical skills in our optometry programme by replacing traditional clinical assessments with OSCEs and to evaluate their performance.

Methods: We developed an OSCE for a first year optometry module comprising five 10-min stations: case history, direct ophthalmoscopy, retinoscopy, subjective refraction and ocular motor balance. For each station, a checklist and marking scheme was developed using a panel of expert assessors.

For each station, examiners scored the students’ performance using the checklist. Examiners also made a global judgment about student performance using a rating scale (bad fail, fail, borderline, pass, good pass). The borderline rating was used as the performance standard for passing a station.

Results: For each station and student, global rating was plotted against checklist scores. The resultant data were fit with a linear regression to determine the pass mark for the station (using the borderline rating). The results for two first year cohorts of students (77 students in total) revealed an average pass mark across stations of 67%, which was much higher than previous assessment formats. Students with higher checklist scores also tended to be rated more highly by examiners; however, this was not universal and some students scored highly (e.g. 80%) on a station but were rated as fail by the examiner. The slopes of the regression lines were different from zero (p < 0.05) but not across stations (p > 0.05). Feedback from students and examiners was overwhelming positive.

Conclusion: The OSCE and performance based standard setting resulted in higher average pass marks suggesting an improvement in student learning and clinical skills. Both students and examiners readily accepted the new format. We recommend the OSCE for use in undergraduate optometry courses.

Intraobserver and interobserver regional variations in Schiotz tonometry measurements

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Background: The magnitude and variation of scleral and ocular rigidity is relevant to our understanding of the development of myopia and ocular pathology such as glaucoma and age-related macular degeneration. To date, the principal method of measuring rigidity in vivo has been to employ the Schiotz indentation tonometer despite its inherent variability, technical limitations and reliance on data transformation. We examine whether data provided by the Schiotz tonometer are sufficiently robust to reliably assess regional variations in scleral and ocular rigidity.

Objective: To determine the effects of intra- and inter-observer variation on the precision of Schiotz tonometer readings.

Methods: Schiotz tonometry was performed on both eyes of 25 normal young adult subjects by two independent observers on two occasions using 5.5 and 7.5 g plunger loads on the cornea and four scleral quadrants; superior temporal (ST) and nasal (SN), inferior temporal (IT) and nasal (IN). In addition each observer measured one subject five times at different occasions. Data were analysed using coefficient of variation (CV) and percentage error (PE) for intraobserver and interobserver concordance was evaluated by intra-class correlation coefficient (ICC) and PE.

Results: Intraobserver CV varied with site of measurement, with highest repeatability on the cornea (5.5 g: 9.37%; 7.5 g: 12.63%) and lowest at IT (5.5 g: 30.2%) and IN (7.5 g: 28.4%). Intraobserver differences in PE were not significant. The 5.5 g and 7.5 g readings showed the cornea to have the least PE (5.5 g: 20.39 ± 22.32%, 7.5 g: 12.63%) and lower values were obtained for cornea (5.5 g, 16.86 ± 10%, 7.5 g to have the highest ICC 0.682 for cornea and lowest ICC 0.342 at IN, whereas 7.5 g had lower values of ICC 0.388 for cornea and 0.187 for IN. No significant difference was found for PE between quadrants; however lower values were obtained for cornea (5.5 g, 16.86 ± 10%, 7.5 g: 14.33 ± 12.27%) and higher values for IT (5.5 g, 29.71 ± 22.86%, 7.5 g, 25.26 ± 18.64%).

Conclusion: Despite relatively high levels of intra- and inter-observer variance the data are sufficiently robust to utilise the Schiotz tonometer for measurement of regional variations in ocular and scleral rigidity.
Changes in human ciliary muscle biometry with accommodation: an anterior segment optical coherence tomography study

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Purpose: To analyse changes in human ciliary muscle biometry with accommodation utilising Anterior Segment Optical Coherence Tomography (AS-OCT).

Methods: Images of nasal and temporal ciliary muscle in various accommodative states were acquired of the right eyes of 13 pre-presbyopic subjects aged 20-31 years (mean age 26.2 ± 2.9 years), using the Zeiss VisanteÂ® AS-OCT (Carl Zeiss Meditec Inc., USA). Images were captured whilst subjects viewed external fixation targets (at an angle of 45°) of 0, 4 and 8 D stimulus vergences, presented in random order. Objective responses to the accommodative stimuli were recorded using the Shin Nippon SRW-5000 autorefractor (Shin-Nippon Commerce Inc., Tokyo, Japan). Images were processed with the VisanteÂ® software (version 1.0.12.1986; Carl Zeiss Meditec Inc.) to obtain measures of axial ciliary muscle length (measured from the scleral spur to the posterior visible limit of the muscle) at each accommodative state.

Results: The expected shortening of ciliary muscle with contraction during accommodation was shown. No significant difference was found between the response of nasal and temporal ciliary muscle (F = 0.04; p = 0.84). Mean ciliary muscle lengths at 0 D, 4 D and 8 D were 3.84 ± 0.47 mm, 3.68 ± 0.46 mm and 3.57 ± 0.49 mm, respectively (F = 0.84; p = 0.45), showing a linear regression model of ciliary muscle length with accommodation: c = 0.051 ± 0.040 mm per dioptre of accommodative change.

Conclusions: The AS-OCT represents a new, non-invasive method of quantifying in vivo accommodative changes in human ciliary muscle biometry. Further larger-scale studies analysing both young subjects and presbyopes will utilise AS-OCT to analyse biometric variables other than ciliary muscle length, including thickness and cross-sectional area.

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Refractive error and axial length in children and young adults with cerebral palsy

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Background: Individuals with cerebral palsy (CP) have an increased incidence of significant refractive errors (Schenk-Rootlieb et al., 1992; Sobrado et al., 1999; Kozeis et al., 2007). Developmentally normal individuals demonstrate a strong association between refractive error and axial length, however this association does not generally hold for corneal curvature (Mutti et al., 2005; Olsen et al., 2007; Grosvenor & Scott, 1994). The present study investigated the relationship between refractive error and ocular biometry measurements in a group of 43 children and young adults with CP, aged 4-19 years.

Methods: Cycloplegic retinoscopy (with 1% cyclopentolate HCL) was used to establish refractive error. Axial length and corneal curvature measurements were taken with the Zeiss IOLMaster (Carl Zeiss Meditec, Jena, Germany) and the Nidek KM 500 autokeratometer (Nidek Co Ltd, Gamagori, Japan) respectively. Where possible five axial length measurements and two corneal curvature measurements were taken and averaged for the right and left eyes.

Results: Refractive error was successfully measured in all subjects and mean spherical equivalent (MSE) ranged from -7.13 D to +6.38 D (mean ± 1.18 D S.D. ± 2.99 D). Axial length was successfully measured in 35 subjects and corneal curvature in 33 subjects. Axial length ranged from 18.94 to 27.47 mm (mean 22.85 mm S.D. ± 1.59 mm); and average corneal curvature ranged from 7.28 to 8.45 mm (mean 7.77 mm S.D. ± 0.24 mm). MSE refractive error demonstrated a statistically significant correlation with axial length (linear regression r² = 0.86, p < 0.0001) but corneal curvature showed no correlation with refractive error (linear regression r² = 0.01, p = 0.64).

Conclusions: Individuals with CP have a wide range of refractive error. As for developmentally normal individuals, this study shows that axial length is a strong correlate of refractive error, and that 86% of the variance in refractive error is attributable to axial length. The mechanism for increased incidence and magnitude of refractive errors cannot be explained by ocular biometric factors, and further investigation is required to understand why children with CP often fail to emmetropise.

References


Assessing functional visual fields in the visually impaired

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Purpose: Accepted standards exist for assessing monocular visual fields to detect pathology and monitor progression, but there is no standard method of binocular assessment of habitual functional fields. Monocular Humphrey Field Analyser (HFA) 24–2 thresholds have been integrated to provide ‘binocular’ fields (Nelson-Quig et al., 2000), with some success in relating to self-reported function (Crabb and Viswanathan, 2005; Jampel et al., 2002). Binocular testing has generally used single-intensity suprathreshold tests such as the Esterman, which is insensitive when correlated with self-reported visual function (Crabb and Viswanathan, 2005; Jampel et al., 2002). This study evaluates methods of binocular visual field assessment as potential measures of functional field performance.

Methods: 16 people with established visual impairment affecting their daily lives were recruited. Habitual binocular VA ranged from 0.30 to 1.76 logMAR (mean 0.93 ± 0.37 logMAR). Visual fields were assessed binocularly using the threshold HFA programmes 24-2 and 10-2 SITA Fast, suprathreshold (age-related gradient-adapted) P60, and an Amsler chart. Fixation was monitored manually and rated using a grading scale. Self-reported visual ability was assessed using the Activity Inventory (Massof et al., 2007).

Results: Fixation in 73% of fields was rated as ‘good’, and false
positives and negatives were < 33% in virtually all cases. Visual field outcomes were compared against Activity Inventory person measures. P60 and Amsler results were not significantly correlated with self-reported visual ability. Mean thresholds of the threshold field programmes showed significant correlation with self-reported visual ability ($r = -0.51$, $p < 0.05$ for 24-2; $r = -0.65$, $p < 0.01$ for 10-2). 24-2 fields could be subdivided with the equivalent field area showing strong correlation with 10-2 data ($r = 0.92$, $p < 0.001$).

**Conclusions:** Binocular static threshold perimetry can be used to assess functional visual fields. Reliability indices were satisfactory and implementing an operational grading scale aided manual fixation monitoring. Mean static thresholds (10-2) could explain up to 42% of the variance in self-reported visual ability. However, it is suggested that the 24-2 is a more useful test, taking information from a wider area of visual field, but allowing information from very central visual field to be obtained by sub-division of the field plot.

**References**


