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2008 Volume 40 (2)

Review of the Evolution of Colour Vision Testing

Orthoptic Role in the Management of Contact Lens Use in Infants

Clinical Measures as Indicators of Performance of Daily Activities in Vision Impaired Children

Beyond Clinical Measures of Ocular Function

AUSTRALIAN ORTHOPTIC JOURNAL – 2008 VOLUME 40, NUMBER 2

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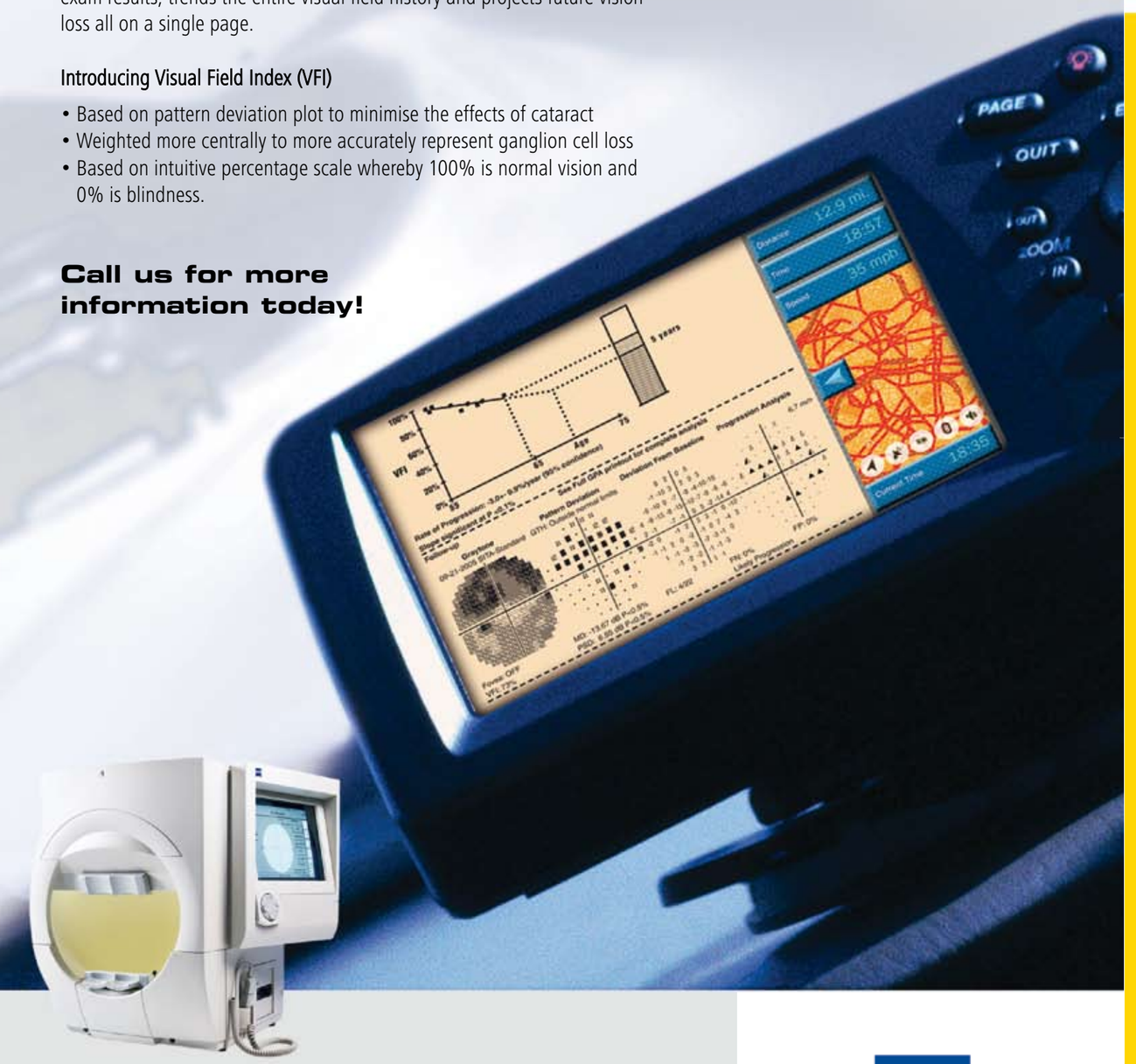

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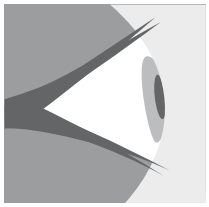

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Editorial

Looking for you, looking for us?

The Australian Orthoptic Journal is the only English-language peer-reviewed orthoptic journal to be published biannually. In the last two years, we have managed to gain good support from academics and research students particularly, and we would like to encourage more clinicians to also submit work for publication. The AOJ is indeed a scientific publication but also one that belongs to professional clinicians not professional scientists necessarily; so, bring on the case studies, which often clinicians comment are the 'best read', bring on the clinical perspectives and review papers, and where are those clinical audits? Clinical audits highlighting management outcomes are imperative to a profession like ours given that we have strong interest in maintaining quality in the delivery of patient services and care. This is a call to our clinically based community to consider publishing your good work in the AOJ – we look forward to hearing from you.

On another note, we know that over time appearances change and so too does function! The current look of the AOJ has received favourable review from our colleagues, but soon it will have an online presence added. We are currently planning for an '09 launch of the new AOJ website, which will serve to take our work further afield and allow it to be more easily searchable. In the meantime you can visit the Association's website for the journal's table of contents. And whilst speaking of websites and searching… did you know that you can now search the contents of the AOJ at a University of Liverpool webpage? Similarly, you can search contents of the British & Irish Orthoptic Journal and various transaction papers from the congresses of the International Orthoptic Association, International Strabismological Association and European Strabismological Association. Go to http://www.liv.ac.uk/orthoptics/research/search.htm. Thanks to Dr Fiona Rowe (who is on our Editorial Board) and her collaborators; we can now search these publications for our reference.

Zoran Georgievski & Connie Koklanis
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The Evolution of Colour Vision Testing

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ABSTRACT

Colour vision testing forms an important part of the assessment of retinal pathology and congenital colour vision anomalies. Although the traditional Ishihara test and other pseudoisochromatic plates are relatively simple to use, some are not designed for the assessment of more complex acquired defects, and hue discrimination tests can be very time consuming to administer and analyse. This review outlines the theoretical development and historical evolution of colour vision tests, from the 19th until this early part of the 21st century. Based on these developments, speculation is made on how the tests will evolve in the future, with increasingly refined computer technology, and predicts that they will provide consistent and robust assessments of colour vision that will become routinely used in the clinical environment.

Keywords: colour vision testing, pseudoisochromatic plates, Farnsworth-Munsell 100-Hue, computer-assisted diagnosis, computerised colour vision tests.

INTRODUCTION

Historically, the development of colour vision tests was driven by two major forces. The first was the need for vocational tests to ensure accurate colour vision in professions and industries such as electrical, textiles and the railway, navy, and armed forces. This was particularly fuelled by safety concerns following a series of accidents in the railway and shipping industries caused by the misinterpretation of coloured signals.[1] The second was to create accurate clinical tests to screen for congenital colour deficiencies and to diagnose acquired colour defects.

Despite the great advances in the development of colour vision tests since they were first created in the 1800s, there is no single colour test that can rapidly and accurately screen, diagnose and classify any colour vision defect. This means that selection from the colour vision test battery must be made carefully according to the type of defect and the level of information that is required. Therefore, it is imperative that clinicians have a firm understanding of the types of colour vision tests available and the colour deficiencies they are most appropriate to examine.

This review aims to describe the foundations and historical development of colour vision tests, the clinical tests that are currently available and recent advances in colour vision testing methods.

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COLOUR VISION THEORIES

Colour vision deficiency was first described as a physiological failure of visual function by John Dalton in 1798.[2] Many theories on the mechanisms of colour vision and colour vision deficiency have since been proposed, each one advancing on the last.[3-11] Colour vision testing methods have tended to reflect the theory and technology of their time.

It was noted by several researchers in the 1700s that any one colour could be matched by the proportionate mixture of just three colours; red, yellow and blue. These were named the primary colours. This notion of trichromacy in colour vision became widely accepted, however, it was assumed to be a property of light rather than the physiology of sight.

In 1802, Thomas Young delivered his lecture 'On the Theory of Light and Colours' that presented the trichromatic theory. He hypothesised that "As it is almost impossible to conceive each sensitive point of the retina to contain an infinite number of particles… it becomes necessary to suppose the number is limited, for instance, to the three principal colours, red, yellow and blue".[3] Several months later, Young was compelled to change his three principal colours to violet, red and green[4] after the experiments of William Wollaston[5], who observed that yellow could be obtained from a mixture of red and green, and therefore it could not be a primary colour.

Later, Young's trichromatism theory was revised by Hermann von Helmholtz[7] who conducted trichromatic colour matching experiments, finding that in some cases the mixture became

desaturated and could not be matched to the test colour, leading him to realise the spectral sensitivities of the retinal receptors must overlap. This was such an important finding that the Trichromacy Theory then became known as the Young-Helmholtz theory of colour vision.

In 1878, Ewald Hering[8] proposed a new theory that humans see four primary colours; red, blue, green and yellow and suggested that these colours were arranged in opponent pairs; red-green and blue-yellow. A few years later, Donders[9] (1881) proposed that it was feasible that Trichromacy may occur at one stage in the visual pathway and Opponency at another. These theories form the basis of modern colour vision models.

HISTORICAL EVOLUTION OF COLUR VISION TESTS

Early vocational assessments of colour vision were made by an individual naming the colour of everyday objects, with their responses compared to those of an observer with normal colour vision[12] The first commercially available test, the Holmgren Wool Test (1875) was designed for examining train drivers[13] It consisted of many different coloured wool skeins that had to be matched to three large test skeins coloured red, green and purple. The colours of these test skeins were based on an erroneous proposition that the types of colour defect were distinct; red-blindness, green-blindness or violet-blindness[13] This severely impaired the accuracy of the Holmgren test, and the visual task itself led to errors[14]. A number of variations of this type of test were developed, the most common of these being the Edridge-Green Bead Test (1891)[15].

The next advance in vocational colour vision testing came in the early 1900s with the introduction of lantern tests designed to mimic the light signals used in rail and sea transport. These tests provided a fast method of detecting unsafe colour vision defects for such industries. The most popular lantern tests have been those devised by Edridge-Green (1891)[15], Farnsworth (1943)[16] and more recently Holmes and Wright (1975)[17]. Lantern tests are still in use in the transport, maritime, aviation and naval industries.

The Stilling test was the first clinical colour vision test to be developed and the first to utilise pseudoisochromatic principles. Pseudoisochromatic plates have their foundation in the Opponency Theory[8]. When considering cases of colour deficiency, discrimination of one colour in an opponent pair is compromised and as such, the colours of the pair appear isochromatic and will be confused. Therefore, Stilling performed colour matching experiments with two dichromatic subjects, one with a blue-yellow defect, and the other with a red-green defect, to determine the exact hues perceived as pseudoisochromatic. Their matches form the basis of pseudoisochromatic plate tests used today. The Stilling test was initially well accepted, however, it was eventually surpassed by the Ishihara pseudoisochromatic plates. The Ishihara remains the most commonly performed screening test for colour vision[18].

The pseudoisochromatic tests fulfilled the screening requirement for the detection of colour vision deficiency, however, they lacked the ability to grade the severity of colour defects. They were also unable to grade the degree of discrimination within subjects who had normal colour vision. Hue discrimination tests originally designed for vocational colour assessment[19] were able to measure these gradations in normal and abnormal observers, and have therefore become commonly used in clinical settings.

The Farnsworth-Munsell 100-Hue test (F-M 100) is the most widely used hue discrimination test. It was created by Dean Farnsworth in 1943 to detect those with superior colour vision for employment in industries requiring a demanding appreciation of colour[19]. It has since been found to be valuable in assessing acquired defects, particularly in monitoring their subtle progression[20].

Other hue discrimination tests based on the same principles as the F-M 100 have also been developed. The Farnsworth-Munsell Panel-D15 test is a shortened version of the F-M 100 used for a more rapid assessment. The test divides observers into two categories; those who pass with normal or mildly deficient colour vision, and those who fail with moderate or severe colour deficiency. Desaturated versions of the D15; the Adams[21] and Lanthony tests[22] are used to further discriminate those who pass the D15, giving a finer grading of severity

CURRENT CLINICAL VISION TESTS (TABLE 1)

PSEUDOISOCHROMATIC PLATE TESTS

Pseudoisochromatic colour vision tests have a long standing acceptance in research and clinical practice. These tests consist of plates with a central test figure such as a number, picture, symbol, or pattern that can be traced by an illiterate subject. The test shapes and background are composed of variably sized dots randomly placed. The test figure is delineated from the background by colour and can be readily detected by a person with normal colour vision. However, for people with abnormal colour perception, the plate testing their particular colour deficiency will appear isochromatic and therefore, the test figure will either be invisible or confused.

Originally, pseudoisochromatic plate colours were hand painted but this was superseded with the introduction of colour printing. The speed of this approach made pseudoisochromatic tests more broadly available and popular amongst clinicians.

The process of printing did pose some problems. Subsequent editions of the same test often vary in the colour properties of plates. In the case of the Ishihara test, small differences in colour and residual brightness cues between editions are apparent[23], although it does not appear to affect the sensitivity and specificity of the test[24]. In contrast, the third edition of the Hardy Rand Rittler test (HRR) was flawed because of visible differences in hue and saturation[25,26].

Table 1: Comparison of Standard Clinical Colour Vision Tests

Test Type	Test Name	Year of Developed	Reliability	Screening	Severity Diagnosis	Congenital Red-Green	Tritan	Acquired	Comments	Age Group
Pseudo-Isochromatic	Ishihara	1917	Sensitivity 0.93 Specificity 0.98 [24]	✓	×	✓	×	×	Illiterate plates	>=6 yrs [67] *
	Hardy Rand Rittler	1954	Sensitivity 1.0 Specificity 0.96 [36] (4th edition)	✓	✓	✓	✓	✓	Use of symbols makes it suitable for children.	>=3 yrs [67] *
	Matsubara	1957	Sensitivity 0.07 Specificity 0.90 [37]	✓	×	✓	×	×	Designed for children Pictures- some are culturally specific to Japan and pose a problem for western populations	>=3 yrs [38]
	Colour Vision Testing Made Easy	Late 1990s	Sensitivity 0.90 Specificity 1.0 [39]	✓	×	✓	×	×	Pictures and Matching Designed for children.	5-7 yrs [39] †
Hue Discrimination	Farnsworth-Munsell 100-Hue	1943	Sensitivity 1.0 Specificity 0.83 [61]	×	✓	✓	✓	✓	Very fine grading of colour discrimination, ideal to monitor acquired defects.	>=8 yrs [67]
	Farnsworth-Munsell Panel-D15	1947	-	×	×	✓	✓	✓	Much faster to administer than FM 100.	>=8 yrs [67]
	Lanthony D15	1978	-	×	×	✓	✓	✓	Used in combination with the original D15. Desaturated colours.	>=8 yrs [67]
	Adams Desaturated D15	1982	-	×	×	✓	✓	✓	Used in combination with the original D15. Desaturated colours.	>=8 yrs [67]
	City University (2nd edition)	1972	Sensitivity 0.95 Specificity 0.83 [58]	✓~	×	✓	✓	✓	2nd Edition contains desaturated plates to detect mild defects.	>=4 yrs* #

*Originally designed exclusively for use in adults but has been shown to be useful in examining children also.

No verifiable data for appropriate age group is available in the literature, however, the City University test is readily used in the clinical setting for children >4 years of age.

† Verified for use in children of this age[38] but is designed also for use in younger children.

~ Not originally designed as a screening tool, but is commonly used as such.

The Ishihara Test

The most commonly performed pseudoisochromatic plate test is the Ishihara, and several editions have been published. It is used as a quick and reliable[18] screening test for accurate identification of congenital red-green colour deficiencies[27]. Despite this, there are some short-comings of the test, arising predominantly through administration under non-optimal conditions and/or misinterpretation of results.

Appropriate illumination is essential for the correct and consistent display of colours in all colour vision tests. The majority of pseudoisochromatic plate manufacturers recommend that the test plates are well illuminated by daylight or by using a daylight globe with a colour temperature of close to 6740° Kelvin. Similarly, other testing parameters such as testing distance should also be kept consistent. The Ishihara test manufacturers recommend a testing distance of 75cm be used with the plates held at a right angle to the line of vision[27], however, this is rarely adhered to. Other testing distances suggested have been 2/3m and arms length[28].

The level of VA has been shown to affect Ishihara test performance and appropriate refractive correction should always be worn. A study by McCulley et al[29], using plus lenses to reduce the visual acuity in normally-sighted subjects showed that of three common colour vision tests; Ishihara, Farnsworth D15 and Hardy-Rand-Rittler (HRR), Ishihara was the most dependent on a good level of VA. Test performance was significantly affected with a VA level of less than 0.72 logMAR (≈ 6/30). The possibility misdiagnosis of patients with poor vision as having a colour defect needs to be considered.

Some eye care professionals incorrectly interpret any error on the Ishihara test plates as being indicative of a colour vision defect[30]. The pass/fail criteria recommended by the publishers in recent editions is that correct reading of 17 of the 20 screening plates can be regarded as denoting normal colour vision[18]. This is especially important to note, as the scripted font used in the Ishihara test has been shown to contribute significantly to misreadings by colour normal observers[31,32]. Failure to note this design characteristic can lead to the misclassification of individuals with normal trichromatic colour vision. If 12, or fewer plates are read correctly then the person can be said to have defective colour vision[18]. It is recommended that if between 12 and 17 plates are read correctly additional examination with other colour vision tests should be performed.

Finally, some eye practitioners may be unaware that Ishihara cannot be used as an all encompassing test for the detection of colour vision defects. As there are no tritan plates Ishihara is only suitable for examining red-green defects, and cannot detect tritan defects which are predominantly acquired. A further common misconception is that Ishihara may be used to test for acquired red-green defects[30]. This is a significant issue as the use of Ishihara to screen for acquired defects when disease or toxicity is suspected, and or record baseline data prior to commencing treatment known to cause retinal toxicity, may result in misdiagnosis and failure to undertake appropriate treatment.

The Hardy Rand Rittler Test

The Hardy Rand Rittler test (HRR) is another common pseudoisochromatic test predominately used in the USA. It intended to be a single test to screen and diagnose both red-green (protan and deutan) and blue-yellow (tritan) colour defects. Unlike other pseudoisochromatic tests the background matrix of dots in the HRR are shades of grey varying in luminance rather than colour. The test figures are geometric symbols; a cross, a triangle or a circle which are coloured specifically to appear achromatic to either a protan, deutan or tritan observer. The colour of the test figure gradually increases in saturation over successive plates, effectively increasing the colour difference between the figure and background. This enables a diagnosis of mild, moderate or severe to be made.

The original version of the HRR received great acclaim, showing a very high sensitivity and specificity on repeated testing[33,34]. Unfortunately, the long awaited third edition showed visibly different colour saturation and as a result was not well received. The recent fourth edition more closely reproduces the colours of the original test[25], and studies have found its validity to be much improved on the inadequate intermediate editions[25,26,35].

Pseudoisochromatic Plates for Children

The examination of colour vision in young children has still not been refined into a reliable and universal procedure. Quite often, Ishihara is used as the gold standard to screen for colour vision defects in school aged children. The HRR test is also useful for children and as it incorporates symbols and shapes, however, it is not always readily available outside the United States.

Other pseudoisochromatic test plates have been designed specifically for children, quite often using pictures or symbols as the test figure rather than a numeral. Some of the more widely available are Kojima-Matsubara[36,37] and the Colour Vision Testing Made Easy (CVTME)[38] test. None of these have successfully surpassed Ishihara as the 'gold standard' screening test, partly due to a lack of validation in the literature. They do, however, increase the age range that may be tested for colour vision deficiencies.

HUE DISCRIMINATION TESTS

Hue discrimination tests are in relatively common use in clinical settings but unlike pseudoisochromatic plate tests they are not designed as a screening tool. They are specifically designed for detecting all types of colour deficiency and as such, can be used to examine both acquired and congenital, and both red-green and blue-yellow defects. Hue discrimination tests usually require the observer to place discs of varying hue into a sequence which progressively changes from a fixed colour at the beginning and end of the sequence being tested. Other tests require matching of closely related hues. Hue discrimination tests are rather more complex than pseudoisochromatic plates, and quite often give a more comprehensive assessment of a patient's level of colour vision.

Also, unlike pseudoisochromatic plates, hue discrimination tests do not pre-suppose the type of colour confusions that might be present[19]. This makes hue discrimination tests useful in the assessment of acquired colour deficiencies[20], and as such, are essential for examining colour vision in cases with pathology. The number of errors made can often be used to determine the severity of the defect and monitor subtle progression. This characteristic also makes these tests valuable in assessing the colour discrimination aptitude of observers with normal colour vision. This is predominately used vocationally to distinguish those with superior discrimination for occupations requiring a demanding appreciation of colour.

The Farnsworth-Munsell 100-Hue

The F-M 100 is based on the Munsell System of Colours[39], developed by Albert Henry Munsell in the early 1900s. In this system, each colour is given a unique coding according to three characteristics: hue, value and chroma. Hue refers to the dominant wavelength colour, value to the relative lightness, and chroma refers to the colour saturation. Munsell designated five principle colours; Red, Yellow, Green, Blue and Purple and a range of colours intermediate to these, Red-Yellow, Yellow-Green, Green-Blue, and Blue-Purple.

The principal hues are described by their first letter, that is, R for red, Y for yellow and so on. Each hue step intermediate to the principle hues is assigned a number from 1 to 10. The value was also allocated a number between 1 and 10 where 1 describes darkest and 10 the lightest. Similarly, chroma was numbered from 0 which is neutral grey, to 15, which is the most vivid colour. Therefore, a complete colour notation could be written as 4B5/5, which indicates a number 4 blue hue, with a Munsell value of 5 and a chroma of 5.

The colours used in the Farnsworth-Munsell 100-Hue test (F-M 100) form a hue circle of perceptually equal hue steps ranging across the entire visible spectrum whilst maintaining a constant Value/Chroma level of 5/5. The original series of 100 Hues was established by Nickerson and Granville[40] using of a set of experimental Munsell papers prior to being incorporated into the F-M 100. Although researchers had experimented with hue scales prior to this[41-45] none had formed a series which differed only in Hue, while remaining constant in Chroma and that had encompassed the full range of visible colours.

While the original series consisted of 100 hues, Farnsworth found that each step around the hue circle was not quite equal in terms of difficulty[19] and certain steps were particularly prone to causing errors by observers with normal colour vision. As a result 15 caps were removed, leaving a total of 85 hues. Farnsworth's writings on the construction of the F-M 100 do not indicate which colours were removed or where they may fall on the hue circle[19,46]. The impact of this on the validity of the F-M 100 can only be speculated.

It is known, however, that the measured change in hue between each of the F-M 100 caps is not equal throughout the hue circle. The caps that are closest in hue spacing are located in the section confused by tritans (between caps 80 to 85, 1 to 8 and 32 to 52). This variation in hue gradation can lead observers with normal colour vision to make increased errors in this area[47]. Therefore, a slight tritan pattern can be an artefact of the test and must be taken into consideration when interpreting the results. This can also make it difficult to differentiate between an observer with normal trichromatic colour vision and a person with anomalous trichromacy. This is all ready problematic, as anomalous trichromacy is not characterised by a single area of colour confusion[47], rather, it is characterised by minor and generalised mistakes, much like that of colour normal observers with moderate to low discrimination ability.

The final way in which the current F-M 100 colours differ from those described by Nickerson and Granville, is that while the experimental papers were said to have a constant Value and chroma of 5, Farnsworth's writings indicate that this may not be the case for the F-M 100[46]. The likely effect of areas of de-saturation in the hue circle is to increase the errors made by observers with normal colour vision in these areas. Regardless of these fundamental inaccuracies of design, the F-M 100 remains the most valuable clinical test for acquired deficiencies.

Unfortunately, the F-M 100 has some drawbacks, occurring predominately through errors in recording and administration. The recording process, involving arithmetical calculation and graphing of results is both laborious, time consuming, and prone to errors. This has caused clinicians to resort to other less arduous methods of testing colour vision. Another common error results from the examiner's misinterpretation of error scores. This is most often due to ignorance when it comes to the normative values, and the fluctuation of error scores in both the normal and colour deficient population according to age[48-50], macular pigment[51,52], pupil size[52], familiarity with the test[53] and level of colour discrimination[19]. As such, these normative values must be kept in mind when examining error scores on the F-M 100.

Incorrect lighting, coupled with the degradation of colour through sunlight and handling[54], and colour variance already apparent between individual tests can produce erroneous display of the coloured caps. These problems with administration effectively alter the value of caps and allow the patient to discriminate based on these brightness cues rather than hue[55].

Other Hue Discrimination Tests

Farnsworth also developed other, more concise hue discrimination tests using the F-M 100 colours. The most popular has been the Farnsworth-Munsell Panel D-15 (D-15), which was designed for vocational use in the Electronics industry[19]. Other hue discrimination tests have been designed based on the D-15, with some slight changes in colour properties, particularly value. Some such tests are the Lanthony and Adams de-saturated tests. The City University Test is primarily designed for use in children and has the advantage of being able to detect acquired colour deficiencies. The test is produced in book form with a number of plates consisting of a central test colour surrounded by 4 variably coloured dots. The central colour is matched to the peripheral one which is the most similar in hue.

Unfortunately, studies have shown that while the rate of failure for the D-15 and the City University are similar, only 60-70% of subjects with known colour vision anomalies fail both tests[56,57]. As such, the results cannot be used interchangeably as originally intended. A further discrepancy between the two tests is that while City University is less sensitive to protanopic defects, the D15 is less sensitive to detecting deuteranopia[56].

COMPUTERISED COLOUR VISION TESTS

Computer technology, particularly the resolution of colour monitors, graphics display, and storage capacity, has greatly evolved in recent years and computers have become a necessity in everyday life, both at home and in the workplace. Computerisation of colour vision testing has been seen as a way to overcome some of the difficulties in the administration and recording of colour vision tests by making the tests more repeatable and robust for clinical use. This occurs by controlling colour variance between tests, lighting errors and examiner error in calculating and recording results. Additionally, electronic storage of data will assist with the

retrieval of records, allowing rapid comparison of results over time. This is thought to enhance the monitoring of disease progression in acquired deficiencies. The widespread distribution of sophisticated computer technology, and its control of human error and variance in testing conditions, will mean that computerisation is an inevitable next step to improve current testing methods.

There are, however, presently some limitations to computerised colour vision testing. There can be great variation in colour when displayed on different types of computer monitors such as those using Cathode Ray Tubes (CRT) or Liquid Crystal Displays (LCD). There are also potential differences in the resolution of the screens, available colour settings and the amount of drift over time that has occured in these settings. Typically, CRT screens are more suitable for the accurate display of colour, however, they are known to degrade with time and have become largely obsolete with the introduction of newer technology. LCD monitors are widely available but colour settings can drift requiring frequent calibration. A general issue with computers is that while they are very efficient for the storage of results, there is always the possibility of data corruption, loss of data and vulnerability to viruses. Finally, there remains the issue of the discipline required to perform frequent monitor calibration and data back up.

The development of scientifically-based computerised colour vision tests began in the 1980s, however, these tests used technology that was expensive and therefore more appropriate to research than clinical use. Currently, with increasingly advanced computer technology and public availability, there has been an influx of newly developed computerised tests (Table 2). Unfortunately, many of these tests have not yet been validated, and this field remains in its preliminary stages. Additionally, a lack of standardised test procedures for administration of the computerised tests such as, screen type, test distance, room illumination levels and recommendations for monitor calibration is likely to affect the robustness in clinical practice. Numerous colour vision tests have also flooded the internet resulting in the possibility of mass self-screening for colour vision deficiencies. Although in theory this should increase the awareness and detection of colour vision defects, many of these tests have been developed and presented as games and their validity is questionable.

PSEUDOISOCHROMATIC PRINCIPLES

Colour Assessment and Diagnosis (CAD) Test City University

The web-based Colour Assessment and Diagnosis (CAD) Test, developed by City University in London[58], uses pseudoisochromatic principles, presenting a moving coloured square test figure against a neutral grey background[58] The coloured square varies in hue throughout the 90 second test duration. A colour vision defect is detected if at any time the test figure disappears, having become indistinguishable from the background. Random luminance masking of the background and test figure is used to ensure only chromatic, and not luminance differences are used to distinguish the test figure[59]. The CAD test has been found reliable in identifying protanopia and deuteranopia, but its effectiveness in detecting anomalous trichromacy has not yet been tested[60].

Cambridge Colour Test (CCT)

The Cambridge Colour Test (CCT)[61] (Figure 1 part a) also uses pseudoisochromatic principles. Each plate is made up of randomly generated dots which vary in luminance

Table 2: Comparison of Computerised Colour Vision Tests (Unpublished Data)

Test Type	Test Name	Reliability	Screening	Severity Diagnosis	Congenital Red-Green	Tritan	Acquired	Comments
Pseudo-Isochromatic	Colour Assessment and Diagnosis Test (CAD) [61]	Sensitivity 0.93 Specificity 1[61]	✓	×	✓	×	×	Uses a moving square as the test figure. Background is composed of squares of varying luminance.
	Cambridge Colour Test [62, 63]	-	✓	✓	✓	✓	✓	Presentation of test figure within background dot matrix as in Ishihara and Stilling tests. Uses Landholt C as test figure.
Hue Discrimination	Save Sight Institute Computerised FM 100 (SSI FM100)	Sensitivity 0.93 Specificity 0.89 *	x	✓	✓	✓	✓	Based on the Farnsworth-Munsell 100-Hue with identical presentation, size of caps and spacing of the hue circle.
	Portal Colour Sort Test (PCST)[64]	-	×	×	✓	✓	✓	The PCST uses the principles of the Farnsworth tests however uses 18 caps to give a fast assessment of colour discrimination.
	Seohan 85 Hue Test[66]	-	×	✓	✓	✓	✓	Based on the FM 100 however caps are displayed as squares. Like the FM 100 there are 85 caps separated into 4 segments.

and size so that the test figure, a coloured Landholt C, is distinguished by chromatic cues only. To determine the severity of the colour defect, the C is presented at various levels of Chroma (saturation) using a staircase method along each of the axes for protan, deutan and tritan classification. The CCT test is designed not only to rapidly detect defects, but also to give a more detailed assessment particularly in the case of acquired defects. The CCT has been found valid in assessing all colour vision defects[62].

HUE DISCRIMINATION PRINICIPLES

Save Sight Institute Computerised Farnsworth-Munsell 100-Hue Test (SSI F-M 100)

The SSI F-M 100 (Figure 1 part b) was designed to replicate the F-M 100 test while improving scoring speed, and eliminating colour degradation. The program contains 85 hue caps that are identical to the F-M 100 in hue, spacing and size. The original F-M 100 is presented on a black background but the SSI F-M 100 uses a charcoal background to produce effective contrast while maintaining the impression of depth of the caps. The SSI F-M 100 test is also organised and presented as 4 'boxes'.

At the commencement of each box, the caps are randomly presented on the lower half of the screen. The observer is required to move the caps up into position in the tray on the upper half of the screen and to place them in order, relative to the fixed caps at the beginning and end of the test box. As each box is completed the score is calculated by the program and graphed according to the Farnsworth scoring method; that is familiar to clinicians[19]. The results may be saved and printed out as required. It is able to be run on the 'Windows' platform on any computer containing a suitable graphics card and uses a simple 'drag and drop' procedure for the ordering of the caps. This test is still in the research and development stage and is not currently available commercially.

Portal Colour Sort Test (PCST)

The Portal colour sort test (PCST) is also based on the F-M 100.63 The test consists of 4 screens corresponding to the 4 boxes of the F-M 100 test; however, each section has only seven movable colour caps, described as chips. The coloured chips are derived from a colour circle of red-green-blue with each chip positioned at 10 degree intervals. The chips have a saturation (Chroma) and brightness (Value) of 60% with a small amount of random variation between chips. The computer provides automated scoring and plotting on a graph that has a similar format to the F-M 100. A study by Melamud et al[64] found that despite the PSCT test having a smaller number of chips with which to grade colour defects, the results obtained correlated well with the F-M 100 when examining congenital colour vision defects. Assessment of acquired defects has not yet been undertaken.

Seohan 85 Hue Test

The Seohan 85 Hue Test (Figure 1 part c), developed in Korea is also based largely on the F-M 100 test, having 4 separate components and a total of 85 hues that cover the red, green, yellow and blue spectra[65]. It is designed to be displayed on a calibrated computer screen in a darkened room and the results are computed and displayed on a graph similar to the F-M 100. An evaluation of the test determined that statistical analysis of the section error scores could be used to differentiate between congenital and acquired colour vision defects[65].

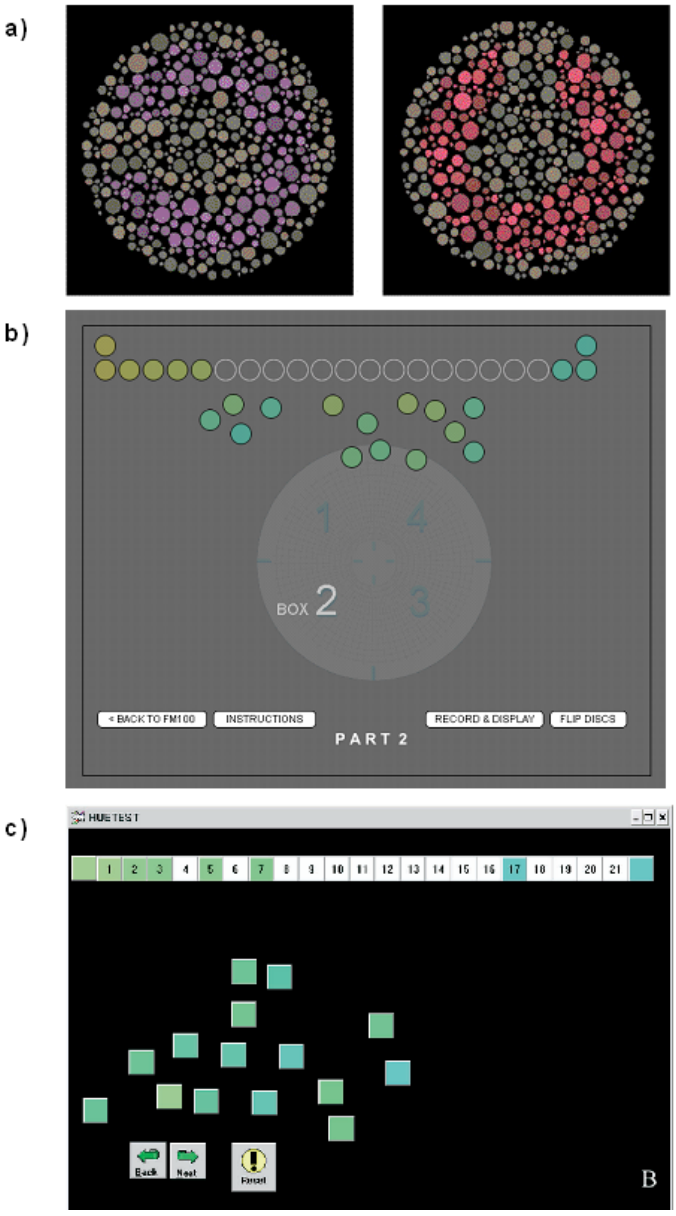

Figure 1. Examples of some computerised colour vision tests. a) Two plates from the Cambridge Colour Test (CCT)[61] b) The appearance of box 2 on the Save Sight Institute computerised Farnsworth-Munsell 100-Hue. c) Box 2 of the Seohan[85] Hue Test[65]

CONCLUSION

Colour vision testing methods have greatly evolved since their emergence in the 1800s. The current standard clinical tests use either Pseudoisochromatic plates or Hue discrimination, however, each of these methods has possible pitfalls for clinicians in administration, recording and interpretation. With the widespread use of high resolution colour monitors and high capacity computers, computerisation of colour vision tests is an inevitable and valuable next step in the evolution of colour vision testing. However, standardisation of these computerised tests is essential to ensure their compatibility with current clinical standards. Continued investigation into their validity and reliability, will inevitably result in consistent and robust computerised colour vision tests. If such robust tests are then coupled with simple and clear administrative instructions and techniques, and an overall user-friendly interface, they are likely to find acceptance amongst eye practitioners and become widely incorporated into the clinical environment in the future.

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The Specialised Orthoptic Role in Management of Contact Lens Use in Infants

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ABSTRACT

Contact lenses are a standard method of correcting aphakia during infancy. Aphakia in infancy occurs secondary to congenital cataracts, PHPV, ectopia lentis and some penetrating eye injuries. Contact lenses may also be used to correct high anisometropic refractive errors in infants. A retrospective review was carried out on patients attending the Eye Clinic at The Children's Hospital at Westmead who required contact lens correction over a seven year period from 2000 to 2007. This paper discusses specialised techniques related to the use of contact lenses in these infants and the orthoptists role in the management of patients with contact lenses.

Keywords: contact lens, infant, congenital cataract, aphakia, compliance

INTRODUCTION

Contact lenses are a standard method of optically correcting bilateral and unilateral aphakia during infancy, until the time when patients may be suitable for an intraocular lens (IOL). Aphakia in infants occurs secondary to surgical intervention for congenital cataracts, PHPV, ectopia lentis and penetrating eye injuries resulting in traumatic cataracts or lens dislocation. Contact lenses can also be used in infants for high anisometropic refractive errors, however this form of treatment is less common.

Congenital cataract is one of the leading causes of form deprivation amblyopia in infants[1]. Early detection and intervention within the first three months of life is vital in achieving an adequate visual outcome. Immediate contact lens insertion following removal of the lens combined with intense occlusion of the better eye, or unaffected eye, is required to achieve the best visual outcome.

Following the removal of the lens from the eye to clear the visual axis, the ophthalmologist has three options for correction of aphakia. These are IOL implant, spectacles or contact lenses. In infants less than 2 years of age an IOL is not preferable due to change in growth of the eye and subsequent change in refraction[2]. This is the process of emmetropisation, or myopic shift, whereby eye growth or an increase in axial length results in a flattening of the cornea and loss of refractive power[3]. IOL implantation prior to 2 years of age therefore often requires additional spectacle or contact lens correction. Spectacle correction of aphakia is impractical due to the difficulty in fitting frames to young children and the weight of the high powered lens. Due to this spectacles are poorly tolerated and can be costly and uncosmetic. In unilateral cases spectacle correction also causes a significant amount of magnification induced aniseikonia which is difficult to overcome[4]. This aniseikonia causes a barrier to fusion and binocular vision and results in the development of amblyopia impacting on visual development. Given the limitations of spectacle use and IOL implant in infants, contact lenses are the preferred method of correction. This paper discusses specialised techniques related to the use of contact lenses in these infants and the orthoptists role in the management of patients with contact lenses. It also provides a review of the contact lens patient population at The Children's Hospital at Westmead (CHW).

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PATIENT REVIEW

The Eye Clinic at CHW specialises in the management of infantile cataracts. The medical records of patients who were being treated with soft extended wear contact lenses between the years of 2000 and 2007 in the Eye Clinic at The Children's Hospital at Westmead (CHW) were retrospectively reviewed.

In total 116 patients were included in the review. Of these patients 66% (n=76) had a diagnosis of congenital cataracts, 20% (n=23) PHPV, 4% (n=5) had a penetrating eye injury causing aphakia, 5% (n=6) had ectopia lentis and 5% (n=6) high refractive errors (Fig 1).

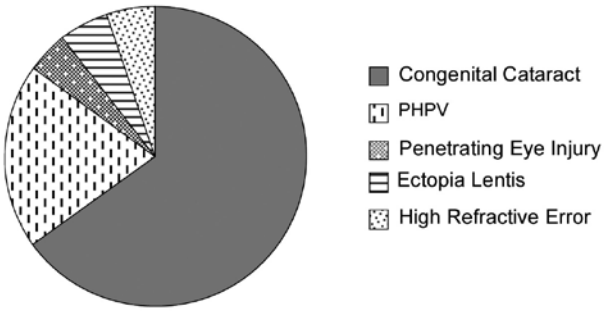

Figure 1. Graph illustrating the indication of contact use in patients at CHW Eye Clinic from 2000 - 2007

The age of patients at the time of the initial contact lens insertion ranged from 2 weeks to 7 years with the mean age being 11 months (SD ± 19.95). The mean age of the congenital cataract and PHPV patients was 2 months (Fig 2).

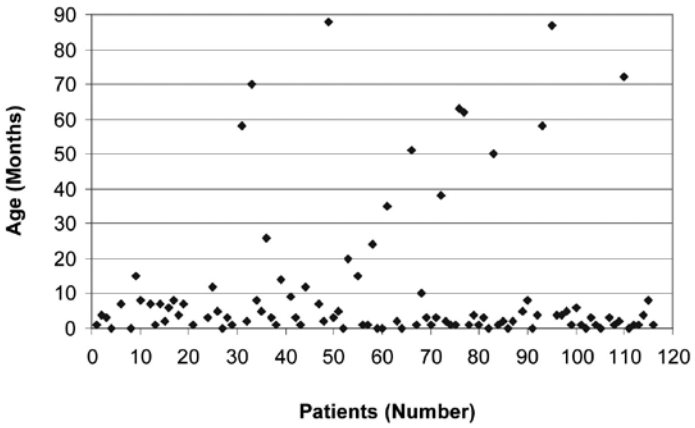

Figure 2. Graph illustrating the age of patients at the time of lensectomy and initial contact lens instruction at CHW Eye Clinic from 2000 - 2007

116 patients with aphakia and high anisometropic refractive error were fitted with soft extended wear lenses. These lenses have a high water content allowing comfortable wear of the lens without removal over seven days. The power of the contact lens ranged from -16.50 to +40.00 diopters (Fig 3) with the mean power +17.5 (SD ± 7.78). The base curve measurement ranged from 7.2 to 8.4 millimetres with the mean 7.6 millimetres (SD ± 0.21) and lens diameter ranged from 10.0 to 14.0 millimetres with the mean diameter 13.8 millimetres (SD ± 0.35).

Schedule of wear was weekly, in which one night out of seven the lenses were removed and cleaned for a minimum of 6 hours, or overnight. Cleaning was performed with a hydrogen peroxide system and the lens was irrigated with saline solution prior to reinsertion at the cessation of

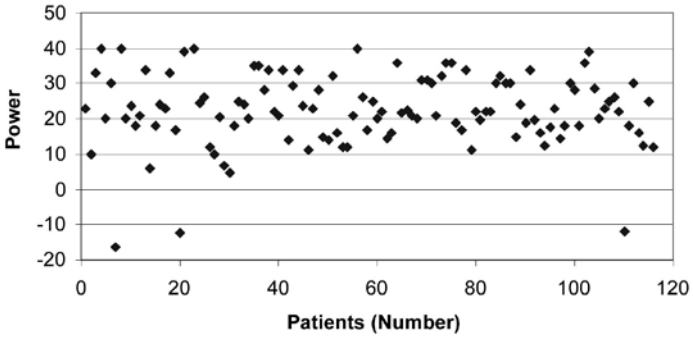

Figure 3. Graph illustrating the range in power of the contact lenses prescribed for patients at CHW Eye Clinic from 2000 - 2007.

cleaning. The hydrogen peroxide system of cleaning has been the preferred method at the Eye Clinic at CHW for the past 13 years with very little complication, and has been found to be very effective. The use of protein tablets are rarely required as the lenses are often lost, torn or changed for fit before protein build-up becomes problematic.

Of the 116 patients reviewed a total of 31 patients (26.7%) had an IOL implant. Age range at the time of IOL implant was 1 month to 7 years with the mean age being 2 years (SD ±25.62). Reasons for unsuitability of an IOL included microphthalmos, anterior segment disorders, inflammation including iritis and uveitis, glaucoma and poor visual prognosis.

THE ORTHOPTISTS' ROLE

At CHW the orthoptist has a vital role in the management and care of infants using contact lenses. The orthoptist is responsible for teaching parents* techniques in insertion and removal of the contact lens as well as education in cleaning procedures, hygiene, and overall care of the contact lens. The orthoptist also provides an important support network for children and families with contact lenses and will often provide ongoing counselling and guidance, building a relationship, which continues throughout their care.

The CHW Eye Clinic provides a service to patients by ordering the lenses direct from the company on their behalf. It takes approximately one to two weeks to receive the lens. An intensive contact lens teaching session is provided and takes approximately two hours. Parents are taught the skill of insertion and removal of the contact lens, a very different skill to insertion in adults. During the intensive session parents are encouraged to insert and remove the lens under the supervision of the orthoptist. A significant amount of patience and practice is required.

Within the intensive contact lens teaching session the protocol to be followed at home is explained and demonstrated. The protocol is as follows. The infant is

placed on an examination table and wrapped in a sheet or blanket to provide comfort and secure the arms and hands. Two adults are needed, initially one being the instructing orthoptist and the other the parent. The parent is positioned at the top of the head with hands holding the head straight and still. They are responsible for ensuring the upper lid is held open, usually with an index finger. The orthoptist picks up the lens in the fan position (Fig 4) pinching one end of the lens gently, being careful not to cause a crease or fold in the lens. With their free hand they hold the infant's head and use their index finger to hold the lower lid down. The lens is then placed on the eye aiming to push the lens up under the top lid. It is flattened onto the eye and the lids are gently released (Fig 5). Once the lens is inserted, the lids are opened and the lens position is assessed. This method models the appropriate insertion technique which will be practised by both parents in the home.

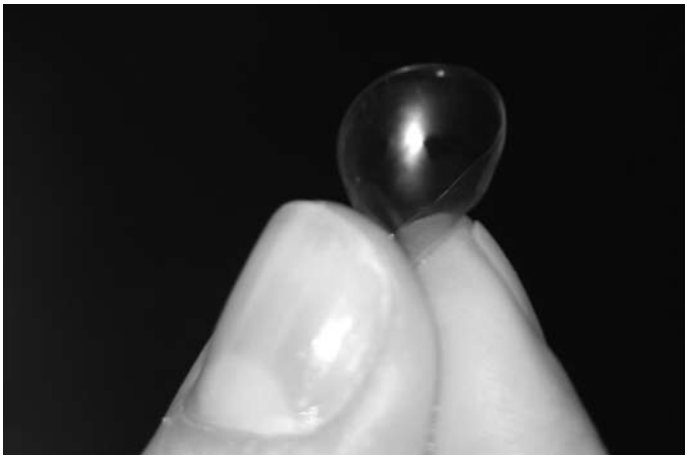

Figure 4. A contact lens held in the fan position

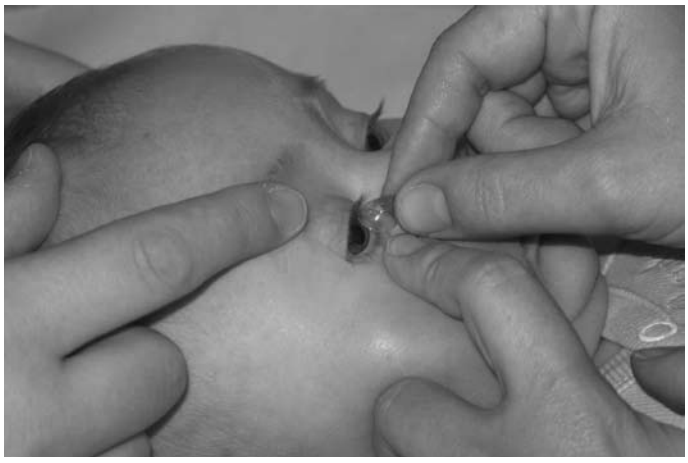

Figure 5. Insertion of a contact lens by the parent with the help of the orthoptist

Fit of the lens is assessed by the orthoptist and ophthalmologist, and if acceptable the patient wears the lens for seven days. The parent is encouraged to attempt to remove, clean and insert the lens at home, and is followed up in the Eye Clinic the following week. If the patient and parent face difficulties with carrying out the removal or insertion they are to return to the clinic to receive hands on help from the orthoptist. This allows difficulties to be addressed and resolved. They are then usually reviewed monthly until three monthly visits are more appropriate. More frequent visits are arranged if necessary.

To assist families a fact sheet was developed by the Orthoptic Department at CHW. All new contact lens patients receive the document during the teaching session. This enables written instruction and provides additional information that parents find useful such as hints and tips from other parents. The orthoptists contact details are also provided on this fact sheet to offer parents with further support if needed once the patient has returned home. After hours care is usually provided by the on call ophthalmology registrar through the CHW Accident and Emergency Department. Patients who live outside the metropolitan area and remote country areas are usually co-managed by a local eye care provider.

POSSIBLE COMPLICATIONS

The use of contact lenses in infants is not always without complication. Patients will often suffer irritation associated with dry eyes. In this instance they may benefit from the use of lubricants. Occasionally a patient will be intolerant to a contact lens once it is inserted. Possible complications if this occurs include infective keratitis, corneal irritation and inflammation and hypoxic ulceration. Watery or purulent discharge and redness is not uncommon. Parents should be informed to remove the lens if this is to occur – 'if in doubt, take it out.'

When lens aspiration and removal is performed in the first few weeks of life there is a risk of developing secondary glaucoma[5]. This impacts on visual outcome, as well as contact lens management of patients because of a change in the size and shape of the eye with the increase in intraocular pressure. In these patients regular refractive changes are observed and changes in power, base curve and diameter of the contact lens are needed. Interestingly, in our experience an IOL implant significantly reduces the risk of secondary glaucoma.

COMPLIANCE

There are many factors that contribute to compliance in contact lens wear. These include age of the patient, anatomical difficulties such as microphthalmia, eyelid abnormalities, small palpebral fissure, systemic associations such as Down's Syndrome and other issues of growth and development such as developmental delay.

Co-operation from parents also determines the success of compliance. In our experience, factors such as multiple

children, being a sole parent, postnatal depression or difficulties accepting the diagnosis of the child are some reasons seen for poor compliance. Two people are required for insertion and removal of the contact lens, a stressful and difficult task. Self confidence and motivation of the parents are contributing factors, along with parental disability and impairments, such as a vision impairment.

Loss of a contact lens is not uncommon and contact lenses are frequently rubbed out or dislodged by patients. Due to the rapid eye growth and changes in refraction during infancy frequent lens replacement is needed, especially within the first two years of life. These factors can result in a costly experience for families and financial pressure has a negative impact on compliance.

Although initially difficult, children and families will tolerate contact lenses well with time. Significant decrease in stress and anxiety experienced by patients and parents to inserting and removing the contact lens can be observed within the first 6 months of treatment[6]. Compared with other aspects of management for aphakia in infants, contact lens use is not a major stressor for most caregivers and patients[7].

AMBLYOPIA MANAGEMENT

Paediatric cataract is responsible for a high proportion of childhood blindness[8]. Prognosis for a good visual outcome is poorer in unilateral cases than bilateral cases[9,10,11]. Up to one-third of infants with unilateral congenital cataracts remain legally blind even after surgical and optical treatment[12]. This is due to the development of dense stimulus deprivation amblyopia which can be very difficult to treat successfully due to compliance issues.

Amblyopia treatment is compulsory in the management of unilateral aphakia following correction with a contact lens. It may also be needed in bilateral cases if there is a detectable difference in visual acuity. At CHW an intense patching regime is commenced in unilateral cases at the contact lens teaching session for half waking hours initially, and then the patching regime is tailored to the individual patient needs. The unaffected eye is occluded by an eye patch, generally an adhesive patch to the skin around the eye (Fig 6). Strong objection to occlusion can be expected by the patient. It is a very stressful time for both the patient and the parent. Patching treatment is continued long term in these cases with a variance in compliance throughout different ages.

Most paediatric patients with cataracts who discontinue contact lens treatment do so because of problems related to the treatment of amblyopia, not problems related to the fitting and wearing of the contact lens[13,14]. Lens use is discontinued as the lens is not perceived to be improving the vision of the patient. Generally patching treatment has failed in these cases because of poor patient/parent compliance. Compliance with occlusion is the factor that is most strongly associated with visual outcome in unilateral and bilateral cases[15,16].

Figure 6. Occlusion treatment with an adhesive patch

CONCLUSION

Aphakia secondary to congenital cataract has the highest incidence in contact lens use in infants. Early detection and treatment to prevent stimulus deprivation amblyopia is vital. Soft extended wear contact lenses are a safe an effective method of treating aphakia and less commonly high anisometropic refractive error. They are generally well tolerated and despite initial difficulty, most parents insert and remove lenses successfully with time. The orthoptist has an important role with contact lens patients and will be responsible for educating parents on care of a contact lenses, teaching insertion and removal techniques, as well as orthoptic assessments including vision and amblyopia management at review visits.

* For the purpose of this paper the term parent is used to describe the parent, care giver or adult responsible for care and insertion of the patients' lens.

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Are Clinical Measures Good Indicators of Performance of Daily Activities in Vision-Impaired Children

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ABSTRACT

Purpose: The aim of the study was to identify whether clinical measures of visual acuity and contrast sensitivity were good indicators of self-perceived performance of activities of daily living (ADL) tasks in vision-impaired school aged children.

Methods: Clinical measures and performance of visual function were assessed in 22 participants (11 fully sighted and 11 vision-impaired children), aged 5 to 15 years. Distance acuity was assessed by LogMAR chart and contrast sensitivity was measured by Vistech grating contrast sensitivity. Additionally, colour vision was also assessed using Ishihara plates as a control. Performance of visual function was evaluated by completion of one of two modified Visual Acuity Questionnaires (VAQ). This questionnaire measured self-perceived level of difficulty in undertaking specified activities graded on a five-point Likert scale. Results of clinical measures were correlated against VAQ scores.

Results: Vision impaired participants reported greater difficulty performing VAQ visual functions than sighted participants. There was an overall trend of a weak to moderate positive correlation between visual acuity and difficulty in performing daily activities measured on the VAQ and a weak to moderate negative correlation between contrast sensitivity and performing daily activities measured on the VAQ.

Conclusion: Data from this study indicated that visual acuity and contrast sensitivity were weak indicators of general performance of visual function. Whilst this represents pilot data the trends demonstrated were similar to others reported in the literature. Further investigation should be undertaken in this domain of low vision, as many intervention programs are directed by clinical measures.

Key words: vision-impairment, visual acuity, contrast sensitivity, activities of daily living, performance of visual function.

INTRODUCTION

Vision is the primary sense of modality used to integrate and co-ordinate the senses during development. Therefore vision loss early in life adversely impacts on the amalgamation of the sensory system, which is essential in learning and developing skills for daily living. A better understanding of the use of clinical vision measures as an indicator of visual performance would form a sound basis for development of effective intervention strategies.

Traditionally, practitioners use clinical measures of vision, in particular visual acuity and contrast sensitivity, as indicators of visual function. Researchers have sought to ascertain whether or not this is a reliable and valid practice.

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Currently, many of the studies surrounding functional performance in the vision impaired are centred on the adult population. For a variety of reasons there is a paucity of research investigating vision and performance of activities of daily living (ADL) in vision-impaired children. Physical tasks and the individual's self-concept and their ability to observe and interact with society in various contexts and environments[1].

Until recently, there had been few low vision studies that have sought to establish a scientific understanding of the relationship between vision measures and performance of visual function[2,3]. However, these investigations primarily involve adult populations and yield conflicting results.

Observation based instruments tend to have strong positive correlation with clinical measures while self-perceived questionnaire based instruments showed weaker correlations[2,4,5,6].

Findings of several cross-sectional surveys and comparative cohort studies concerned with relationships between clinical measures and performance of ADL in the vision-impaired population were variable. Some studies in this area identified strong positive correlation between visual acuity and contrast sensitivity for general ADL tasks, and with specific activities such as face recognition, reading performance, mobility and spatial perception[2,7]. Others report only weak correlation between vision measures and general performance of ADL[5,8]. Inconsistency in outcomes could be a result of inconsistency of measuring instruments used to measure ADL. Whilst there are a number of instruments to measure ADL in vision impaired populations none have universal acceptance. This lack of agreement may reflect the unspecified psychometric properties of the tests and that some have been developed for specific areas of pathology[1,3,5].

Inconsistency in previous findings might also be due to the variety of clinical instruments being used. The logMAR chart has been widely established as the gold standard for assessment of visual acuity however such uniformity has not been recognized for contrast sensitivity. Many low vision studies used the Pelli-Robson chart to assess contrast sensitivity function whilst others have used the Melbourne Edge test, the low contrast visual acuity test and the Vistech[2,7,9]. The Pelli-Robson chart uses a consistent spatial frequency with decreasing contrast. Hence it is not surprising that researchers report the Pelli-Robson to yield moderate correlation when addressing contrast function in medium to low spatial frequencies, such as mobility[10] and often yield weak correlation when used to assess higher spatial frequency tasks such as face recognition or reading performance in children. Although sine wave grating contrast sensitivity tests are less widely used than the Pelli-Robson, Owsley and Sloane[11] found contrast sensitivity assessed at various spatial frequencies correlated well with real-world targets in the middle to low spatial frequencies. The authors have reported that contrast sensitivity function at 6cpd obtained the strongest correlation with "real world" targets, such as faces, road signs and objects.

The research to date has mostly studied the relationship between observed or perceived measures of vision and performance of ADL. These studies have related to adults and there is no evidence to indicate that these outcomes will be similar for children. In addition previous research has provided inconsistent and conflicting results.

There is insufficient paediatric research available to indicate whether a relationship exists between clinical measures and performance of ADL. This research used a causal-comparative correlational design to identify whether clinical measures of visual acuity and contrast sensitivity were good indicators of performance of daily tasks and which if either was a better predictor.

METHOD

This study included 11 sighted (4 male, 7 female) and 11 vision-impaired participants (8 male, 3 female). Participants were further divided by educational level: Primary school, aged 5-12years (M= 8.5 years) and Secondary School, aged 12-15years (M=13years).

Vision-impaired participants were recruited using quota sampling from Vision Australia clients living in Canberra and Melbourne. Sighted participants were recruited using incidental sampling from children of family, friends and professional colleagues' of the primary investigator (ND) with vision of 6/6 or better and no history of ocular pathology. Informed consent was gained from parents/guardians of all participants and informed consent or accent was given by all participants. Potential participants with physical or cognitive conditions that may impair their ability to perform ADLs and those with vision less than 6/120 were excluded from the study.

Participants were assessed in Canberra (n=18) and Melbourne (n=3). The environmental lighting conditions were similar in both environments and the illumination levels for all clinical tests where measured prior to conducting every test. All participants wore current glasses or contact lenses to correct for refractive errors. All testing procedures were performed with both eyes open as this reflected the normal viewing situation and therefore reflected the daily activity conditions.

Visual acuity was measured using the high contrast Bailey Lovie logMAR chart at 6 metres or 3 metres. The measurement was recorded at threshold in logMAR decimals. Threshold was defined as the line which at least 3 out of 5 optotypes were correctly recognized[12].

Contrast sensitivity was measured using Vistech contrast sensitivity chart at 3 metres. Contrast sensitivity was recorded at threshold. Threshold was defined as the least contrast discrimination of each spatial frequency [12].

Colour vision using the Ishihara and estimation of visual field by confrontation were assessed to control for variables that may affect the results of the performance of ADL.

Performance of ADL was assessed using one of two modified Visual Activity Questionnaires (VAQ)[4]. After an extensive search, only one test, the LV Prasad-Functional Vision Questionnaire (LVP-FVQ)[13] was found to specifically assess vision-impaired children. However, this instrument was not culturally appropriate for use with Australian children. An observed based assessment tool to assess performance of visual function was not chosen as there were no observed based tools identified that met the needs of school age children.

The VAQ is a validated research tool designed for use with adults[8,14]. The VAQ provides a direct comparison between clinical measures and eight different aspects of vision function: colour discrimination, glare sensitivity, light/dark

adaptation, acuity/spatial vision, depth perception, peripheral vision, visual search and visual processing speed.

The original questionnaire comprised 33 closed ended questions with a five-point Likert type scale (Never to Always). The VAQ was modified to 24 and 29 item questionnaires. Inappropriate items were deleted and the wording of some items modified so they were age appropriate, but the intent of each item remained the same. For example "I tend to confuse colours" was substituted with "I sometimes mix up colours". The modified questionnaires were reviewed by six experts (three Primary school teachers and three Secondary school teachers, respectively) in child development and behaviour. This review was conducted to ensure age appropriate language was used and to ensure the tasks asked were relevant to the age group. The selected experts were independent of the research project.

Participants attending Primary school completed 24 questions suited to the activities of 6-11year olds and required some parental assistance. Participants enrolled in Secondary school completed 29 questions suited to the activities of 12-18 year olds. The responses from the two age groups were analysed collectively and the composite score for each VAQ visual subscale was calculated. The composite score for a visual function was defined by Sloan and colleagues[4] as "the mean response for the items listed for that visual function." Modification of the questions may have impacted on results and as such is a limitation of the study.

This research was a causal-comparative correlational design. Clinical measures and VAQ composite scores were analysed using Microsoft SPSS version 10.0.

Descriptive statistics including frequencies, mode, median, minimum, maximum, mean, standard deviation, skewness and kurtosis were initially established. Non-parametric Spearman correlation coefficient was employed to analyse the nature, strength and direction of the correlation between each VAQ visual function and visual acuity and contrast sensitivity.

RESULTS

The 22 subjects recruited for this study were aged between 5 to 15 years and 12 of the participants were female. The mean age was 9.96 (SD 2.75) years. The research sample consisted of two equal cohorts of vision impaired and sighted children (n=11). The pathologies causing vision impairment were distributed as follows: ocular albinism 45% (n=5), retinitis pigmentosa 18% (n=2) and Stargardt disease, congenital nystagmus, cone dystrophy and aniridia 9% (n=1). These demographics are similar to those reported in other paediatric low vision studies[9,13].

The mean visual acuity for sighted participants was -0.30 logMAR ± 0.10 or better than 6/6 Snellen. The mean visual acuity for the vision-impaired participants was 0.63 logMAR ±0.23, approximately 6/24 Snellen.

Comparison of the mean values of contrast sensitivity of each cohort is displayed in Figure 1. The mean values for contrast sensitivity for the sighted cohort were within the normal range of contrast function. The vision-impaired participants' contrast sensitivity function at 1.5cpd was within the lower limits of the normal range, however the remaining frequencies (3, 6, 12 and 18cpd) were below the norm. The results of contrast sensitivity of the vision-impaired participants also demonstrated that a greater percentage of contrast was required when the spatial frequency increased (i.e. level of detail increased).

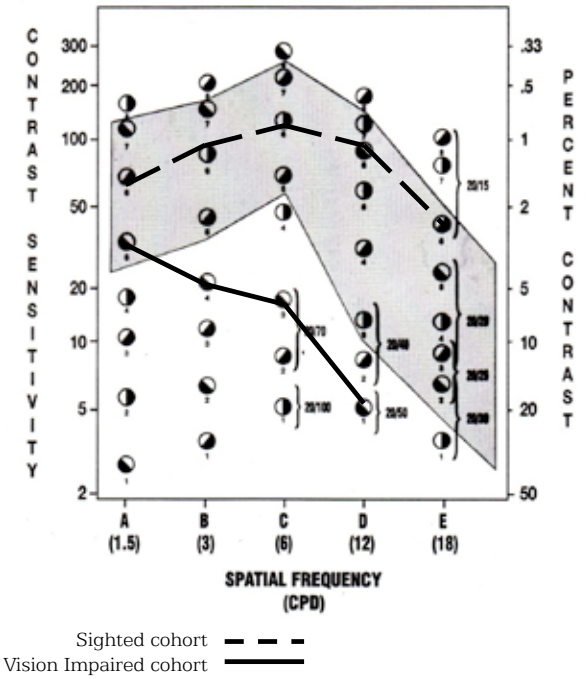

Figure 1. A log plot of mean contrast sensitivity measures as a function of spatial frequency. Results are plotted for sighted (dashed line) and vision-impaired participants (solid line).

Figure 2 compares the sighted and vision-impaired mean response to each VAQ subscale. The graph shows that the majority of the vision-impaired participants reported more difficulty in performing the VAQ visual functions.

Spearman's correlation between visual acuity and contrast sensitivity (at 1.5, 3,6,12 and 18cpd) indicated a significant moderate to strong negative correlation (r^2 = -0.63, -0.87, -0.85, -0.85 and –0.83, $p < 0.01$ respectively). That is, as acuity decreased, the level of contrast required for differentiation (vision) increased.

Analysis of correlation between each VAQ subscale and visual acuity and contrast sensitivity is displayed in Table 1. The results demonstrated a significant positive weak to moderate correlation between visual acuity and the VAQ visual functions. This suggests that as acuity decreases, the reported level of difficulty also increased when performing the activities of each subscale.

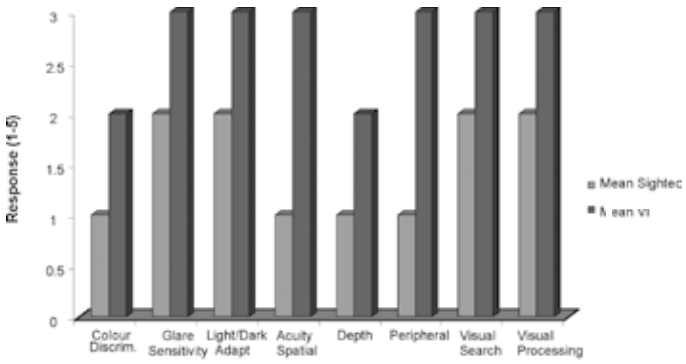

Figure 2. Comparison of the mean values of the VAQ responses between sighted and vision impared cohorts.

Correlation between contrast sensitivity and VAQ subscales indicated a significant weak to moderate negative relationship. This suggests that when contrast was reduced, participants reported a greater difficulty to perform each task. Furthermore, the reported level of difficulty to perform the visual functions increased, as the spatial frequency increased, indicating that as the visual demand of the task increased the task became more difficult to complete.

The contrast sensitivity results indicated that lower spatial frequencies (i.e. 1.5cpd, approximately 3/60 Snellen) demonstrated a weak negative correlation with contrast sensitivity. This suggests contrast sensitivity was a poor indicator of visual function and high contrast was required to ADL when vision was severely reduced. However, contrast sensitivity at moderate to high spatial frequencies (i.e. 3-18cpd or approximately 6/60-6/6) was a good indicators of visual function and performance of ADL.

Both visual acuity and contrast sensitivity had similar strength of correlation with the VAQ subscales. The visual search subscale had the strongest positive correlation with visual acuity ($r^2 = 0.71$, $p < 0.01$) and the strongest negative correlation with contrast sensitivity at medium to high spatial frequencies ($r^2 = -0.66$, -0.70, -0.68 and -0.68, $p < 0.01$ respectively). Stronger correlations where also identified between the clinical measures and colour discrimination, acuity/spatial vision and peripheral vision. Glare disability had the weakest correlation with clinical measures.

DISCUSSION

A weak to moderate correlation, existed between clinical measures and visual function indicative of performance of ADL. The strength and direction of correlation between clinical measures and the VAQ visual functions were varied, suggesting that clinical measures were weak indicators of general visual performance with neither visual acuity nor contrast sensitivity being more sensitive. However, correlation between clinical measures and individual VAQ subscales indicated that these clinical measures were applicable indicators for visual search, colour discrimination, acuity/spatial vision and peripheral vision related tasks. The data indicated that as visual acuity and contrast decreased there was greater difficulty in performing ADL. These trends are similar to those reported in the literature [2,5,6,13]

The frequency of reported difficulty to perform the VAQ visual function tasks was greater in the vision-impaired cohort than their sighted peers. This data supports findings of previous studies that vision-impaired participants had increased self-perceived difficulty to perform visual tasks [2,5,13,15].

Table 1. Analysis of correlation of each VAQ subscale and visual acuity and contrast sensitivity. Spearman's Correlation Coefficient of the sample population.

	visual acuity	contrast 1.5cpd	contrast 3cpd	contrast 6cpd	contrast 12cp	contrast 18cpd
colour discrimination	0.64**	-0.55**	-0.66**	-0.69**	-0.68**	-0.50**
glare disability	0.50	-0.30	-0.37	-0.45**	-0.43**	-0.39
light dark adaption	0.57**	-0.36**	-0.53*	-0.52*	-0.59	-0.52*
acuity/spatial vision	0.69**	-0.52*	-0.62*	-0.61**	-0.67**	-0.62**
depth perception	0.58**	-0.49*	-0.46*	-0.46*	-0.52*	-0.40
peripheral vision	0.64**	-0.39	-0.62**	-0.62**	-0.612**	-0.68**
visual search	0.71**	0.50*	-0.66**	-0.70**	-0.68**	-0.68**
visual processing speed	0.52*	-0.33	-0.38	-0.38	-0.45*	-0.51*

* Correlation is significant at the).05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

The trends between clinical measures and the VAQ subscales were consistent with previous studies using the VAQ to assess visual function in vision-impaired participantS[4,8]. Although the strength of correlation between clinical measures and performance of ADL varied among previous studies, as did the instruments used to assess clinical measures and performance of ADL, measures of contrast sensitivity and visual acuity remained indicative of visual functions related to performance of ADL[2,5,13].

Furthermore, the results of the present study support previous results that used self-perceived questionnaire assessment of ADL. Conversely, the findings were less consistent with those that used observation-based assessment of ADL. This is plausible pattern as the literature indicates that underlying emotional and psychosocial factors somewhat influence self-perceived assessment where as objective observed tasks reduce this effect.

The data reported in this paper represent a pilot study and can only be considered as indicative trend data. However, the data supports the need for a larger age and sex matched comparative study. A valid instrument specifically designed to assess age appropriate daily living tasks is required to assess Australian vision-impaired children. The instrument should incorporate both observed based and self-perceived questionnaire items to provide a comprehensive understanding of performance of ADL in children. Furthermore, a longitudinal study may provide data on the relative rate of development of ADL between sighted and vision impaired children. It may also provide information on whether intervention, based on clinical measures, can influence that rate. The present study also highlights the need for development of an age appropriate instrument for assessment of performance of ADL.

CONCLUSION

This pilot study is one of the first Australian studies to investigate comparison of clinical measures of visual acuity and contrast sensitivity with perceived performance of ADL in vision-impaired children. This investigation found that vision-impaired children generally have greater difficulty to perform visual tasks than their sighted counterparts. Increased contrast appeared to reduce the impact of sight loss in relation to performance of ADL in the vision-impaired cohort.

Although visual acuity and contrast sensitivity had an overall weak to moderate relationship with perceived performance of ADL, these clinical measures provide some information that can be used by service providers to develop individualised intervention programs. Based on this study there was no difference in relevance of clinical data related to visual acuity or contrast sensitivity as a predictor of perceived ability to perform ADL.

Data from this study indicated trends between clinical measures and self perceived performance of ADL. Nevertheless, it is important that further investigation is undertaken in this domain of low vision, as many intervention programs are directed by clinical measures. The development of a valid instrument based on both psychometric and qualitative data to assess functional performance in vision-impaired children is essential in order to establish clinical norms for this population. Rehabilitation strategies for children with vision impairment should be developed with a full understanding of the value and relevance of clinical measures as indicators of visual function.

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Functional Vision Assessment: Looking Beyond Clinical Measures of Ocular Function

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ABSTRACT

Clinical measures of ocular function are commonly used by orthoptists in a variety of settings. However, investigation of functional vision is not often assessed nor quantified. This paper utilises three case reports to highlight the importance of investigating functional vision and describes the use of one such tool useful for this purpose.

Keywords: Functional vision assessment, activities of daily living, clinical vision tests.

INTRODUCTION

Assessment of visual acuity is one of the most important and most efficient tests performed by orthoptists in a wide variety of clinical settings. Visual acuity as measured on a Snellen chart or similar is often the best way to determine the functioning of the fovea. Other clinical tests such as contrast tests, stereopsis, colour vision and visual fields can also provide information about ocular functioning. Whilst these clinical tests of ocular function provide much information, they may not accurately determine the functional vision of a patient[1,2]. Functional vision can be described as the level of a person's functioning whilst performing vision-related activities. These activities include activities of daily living such as reading, writing, recognising faces, driving and walking. Assessment of functional vision is commonly conducted in the vision rehabilitation setting when planning rehabilitation strategies; however it is not commonly investigated in ophthalmic clinics[3-6]

There are several tests for determining functional vision and the Visual Functioning Questionnaire (VF-14) is one such test[7-11]. It comprises of 18 questions covering 14 aspects of general functioning including reading, leisure tasks, mobility, and driving; the format of the questionnaire is shown in Table 1. Although this tool was originally developed to measure functional impairment caused by cataract, it was found to have high internal validity and the general functioning questions relate to common daily tasks performed by people of varying age, including young adults and the elderly[10]. It is easily administered and is not time consuming for the patient or clinician as the average time taken to respond is between 5 and 10 minutes. A percentage score is calculated based on responses from the patient and a person with no vision problems would expect to score 100%.

The aim of this paper is to highlight how the VF-14 has been a useful tool to document functional vision and investigate ability to perform daily living tasks. Three case studies will be used to illustrate the type of information that a functional vision test can provide beyond the information that can be gathered using clinical tests of acuity, contrast sensitivity, stereopsis and colour vision.

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CASE REPORTS

Case Study 1

BC, a nineteen year old female, presented for assessment of functional vision for medico-legal purposes. She had been hit by a glass in the right eye almost 12 months prior and had sustained a small blow out fracture of the orbital floor. There was no entrapment of the eye, extra-ocular muscles or the optic nerve. Optical Coherence Tomography (OCT) revealed a small central foveal defect in the form of a foveal microhole in the right eye (Figure 1). The left eye was unremarkable.

BC's main complaint was difficulty seeing things she could easily see prior to sustaining the injury. She reported problems identifying small numerals and complained of a 'yellow tint' over objects. Snellen visual acuity was 6/6 (-1)

Table 1: The VF-14 questionnaire

Question		Rating*
1.	Do you have any difficulty, even with glasses, reading small print, such as labels on medicine bottles, a telephone book, food labels? Yes ☐ No ☐ Not applicable ☐ If yes, how much difficulty do you have?	0 1 2 3 4
2.	Do you have any difficulty, even with glasses, reading a newspaper or a book?	0 1 2 3 4
3.	Do you have any difficulty, even with glasses, reading a large-print book or large-print newspaper or numbers on a telephone? Yes ☐ No ☐ Not applicable ☐ If yes, how much difficulty do you have?	0 1 2 3 4
4.	Do you have any difficulty, even with glasses, recognizing people when they are close to you? Yes ☐ No ☐ Not applicable ☐ If yes, how much difficulty do you have?	0 1 2 3 4
5.	Do you have any difficulty, even with glasses, seeing steps, stairs or curbs?	0 1 2 3 4
6.	Do you have any difficulty, even with glasses, reading traffic signs, street signs, or store signs? Yes ☐ No ☐ Not applicable ☐ If yes, how much difficulty do you have?	0 1 2 3 4
7.	Do you have any difficulty, even with glasses, doing find handwork like sewing, knitting, crocheting, carpentry? Yes ☐ No ☐ Not applicable ☐ If yes, how much difficulty do you have?	0 1 2 3 4
8.	Do you have any difficulty, even with glasses, writing checks or filling out forms?	0 1 2 3 4
9.	Do you have any difficulty, even with glasses, playing games such as bingo, dominos, card games, mahjong? Yes ☐ No ☐ Not applicable ☐ If yes, how much difficulty do you have?	0 1 2 3 4
10.	Do you have any difficulty, even with glasses, taking part in sports like bowling, handball, tennis, golf? Yes ☐ No ☐ Not applicable ☐ If yes, how much difficulty do you have?	0 1 2 3 4
11.	Do you have any difficulty, even with glasses, cooking? Yes ☐ No ☐ Not applicable ☐ If yes, how much difficulty do you have?	0 1 2 3 4
12.	Do you have any difficulty, even with glasses, watching television? Yes ☐ No ☐ Not applicable ☐ If yes, how much difficulty do you have?	0 1 2 3 4
13.	Do you currently drive a car? Yes ☐ Go to 14 No ☐ go to 16	
14.	How much difficulty do you have driving during the day because of your vision? No difficulty ☐ A little difficulty ☐ A moderate amount of difficulty ☐ A great deal of difficulty ☐	
15.	How much difficulty do you have driving at night because of your vision? No difficulty ☐ A little difficulty ☐ A moderate amount of difficulty ☐ A great deal of difficulty ☐	
16.	Have you ever driven a car? Yes ☐ Go to 17 No ☐ Stop questionnaire	
17.	When did you stop driving? Less than 6 months ago ☐ 6-12 months ago ☐ More than 12 months ago ☐	
18.	Why did you stop driving? Vision ☐ Other illness ☐ Other reason ☐	

* Ratings correspond to 1 = A little; 2 = A moderate amount; 3 = A great deal; 4 = Are you unable to do the activity?

in the right eye, 6/4 in the left eye. Near acuity using the Bailey-Lovie Word Reading Chart (BLWRC) was N5, slow and patchy in the right eye and N4 fluent with the left eye. She had right ocular dominance and extensive questioning revealed that she had started the process of adaptation to left ocular dominance. BC's colour vision (City University Colour Vision Test (CUCVT)) was normal in both eyes, but her contrast sensitivity (Sine Wave Contrast Test (SWCT)) whilst within the normal range, showed a decrease at 6, 12 and 18 cycles per degree in her right eye compared

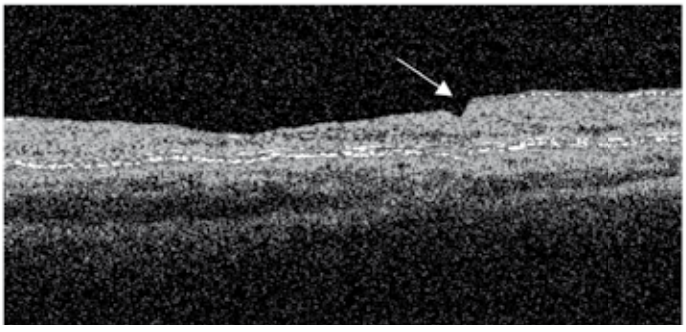

Figure 1. OCT of the right eye, the arrow indicating the foveal microhole.

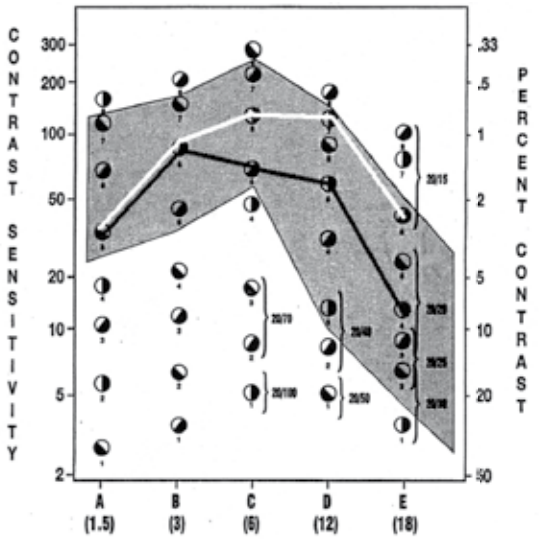

Figure 2. Contrast sensitivity test of the right eye (black line) and left eye (white line)

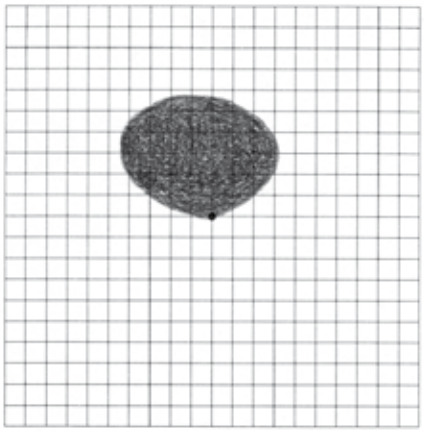

Figure 3. Amster grid defect of the right eye

Assessment of her central vision (Amsler) showed a small paracentral area of distortion and blur superiorly (Figure 3). Stereopsis (Titmus) was reduced to 200" arc.

Case Study 2

Twenty one year old male, JR, developed phototoxic maculopathy in both eyes after prolonged welding without appropriate ocular protection. He presented for a medico-legal assessment of functional vision almost 4 years after the injury and complained of difficulty focusing and particular difficulty reading small print. Fundoscopy showed sub-foveal retinal pigment epithelium de-pigmentation in both eyes. OCT examination confirmed this finding and central foveal destruction is evident (Figure 4). The retinal pigment epithelium and photoreceptors are absent and this is consistent with phototoxic maculopathy.

Snellen visual acuity was found to be 6/12 in both eyes and near acuity was N8 (BLWRC) in both eyes. Colour vision testing (CUCVT) revealed difficulty in the Chroma 2 spectrum, although no specific protan, deutan or tritan loss was evident. Contrast sensitivity (SWCT) showed that his contrast was reduced at 1.5 and 6 cycles per degree with the remaining spatial frequencies at the lower end of the normal range (Figure 5). Stereopsis (Titmus) was 200" arc.

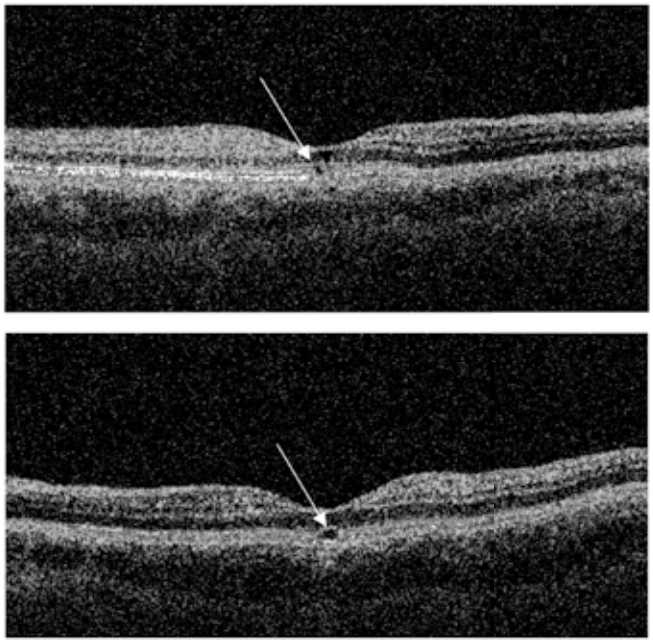

Figure 4. OCT of the right eye (top) and left eye (bottom), the arrow showing the central photoreceptor destruction

A

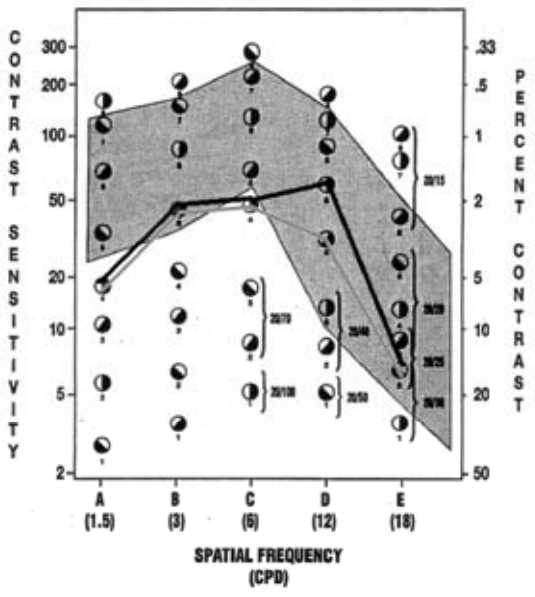

Figure 5. Contrast sensitivity test of the right eye (black line) and left eye (grey line)

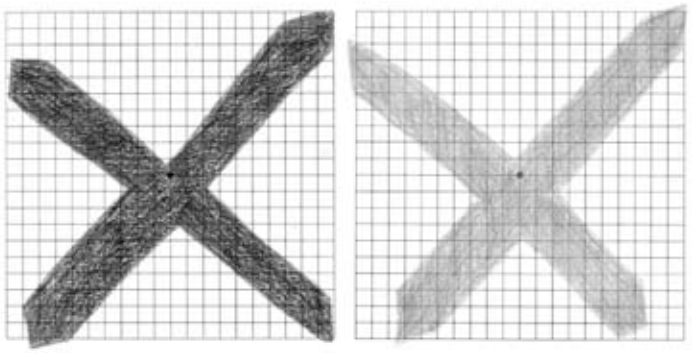

Figure 6. Amsler of the right eye (back) and left eye (grey)

significant defect was found on the Amsler grid in the form of an X-pattern (Figure 6). As JR needed to make constant re-fixations to the centre fixation target in order to see it due to the presence of a non-absolute scotoma, the X-shaped artefact, which he describes as the area where the lines are faded, appears on the grid.

Case Study 3

BW, a 38 year old male, presented for assessment of functional vision as he was seeking employment. Unlike the previous case studies, BW presented with a congenital ocular condition. He reported a history of congenital toxoplasmosis with ocular involvement. Fundus photography shows old retinal toxoplasmosis scarring in both eyes (Figure 7).

BW did not present with any ocular complaints but his potential employer wanted confirmation that he was able to do certain tasks outlined in the job description for the work he was applying for. His best-corrected visual acuity (Snellen) was 6/60 and 6/24 (-1) in the right and left eye respectively and near acuity (BLWRC) was N8 in the right and N6 in the left eye, fluently. Whilst there was no colour vision defect found (CUCVT), his contrast sensitivity (SWCT) was severely reduced in both eyes (Figure 8) and he had no stereopsis response (Titmus). Neither an Amsler grid assessment nor OCT was performed.

VF-14 RESULTS

Each of these patients was asked to complete the VF-14 questionnaire. Based on the clinical tests of ocular function, it was expected that both BC and JR would score the highest, whilst BW would score lowest due to his severely reduced distance visual acuity. However the opposite was true. BC scored 89% on the VF-14 and the test highlighted that she had difficulty reading small print such as that found on medicine bottles, reading newsprint, filling out forms and a great deal of difficulty doing fine

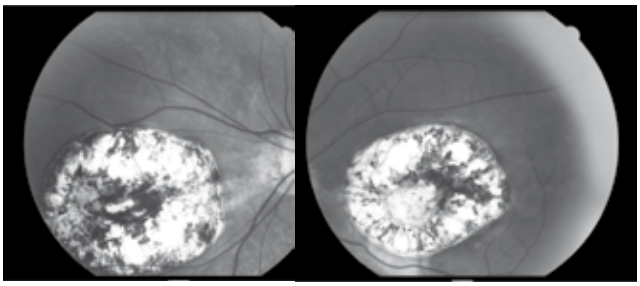

Figure 7. Fundus photography of the right and left eye

handiwork such as sewing. This was especially important to her as dancing was one of her hobbies and she often assisted with making her own costumes. Difficulty with sewing or fine handiwork was not a problem for her prior to her injury. JR's VF-14 score was the most reduced, at 43% and the test revealed that he was functioning very poorly with this ocular injury, despite the fact that his visual acuity was at 6/12. He had difficulty reading small print, traffic signs, filling in forms, watching television and playing sport. The severe impact of the injury on his ability to discriminate fine detail was having a profound impact on his ability to work as a carpenter and he required more time to perform standard tasks required of him in his workplace. BW scored 99% on the VF-14 questionnaire score and he expressed only a very mild problem reading small print.

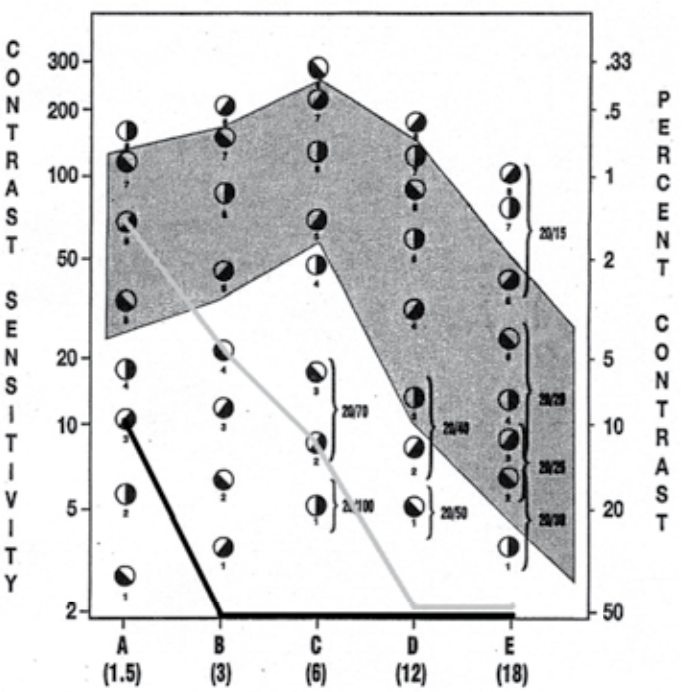

Figure 8. Contrast sensitivity test of the right eye (black line) and the left eye (grey line)

Table 2: Summary of clinical measures for each case			
Clinical Test	**BC**	**JR**	**BW**
Distance VA	R) 6/6 L) 6/4	R) 6/12 L) 6/12	R) 6/60 L) 6/24 (-1)
Near VA	R) N5 L) N4	R) N8 L) N8	R) N8 L) N6
Colour vision	Normal	Reduced++ in chroma 2 range (otherwise normal)	Normal
Contrast sensitivity	R) slightly reduced L) normal	At the lower end of normal	Severely reduced

DISCUSSION

Whilst standard clinical tools of acuity, colour vision, contrast, stereopsis and visual field assessment can provide much information about the patient's ocular health; these tests are not able to quantify functional vision. Exactly determining which daily living tasks a patient with vision problems may be having requires careful questioning. As these three cases indicate, those with the worst performance on clinical tests may not always function poorly whilst undertaking activities of daily living. The congenital nature of BW's ocular problem most likely accounted for the very slight impact his vision impairment had in his life, as opposed to BC and JR who acquired their ocular injury and had not yet had time to make daily living skill adaptations. Had the clinical measures of vision been considered without the functional tests (a summary of these is shown in Table 2) one would conclude that JR and BC were functioning at normal or near-normal levels. However, BW had a higher level of functional vision compared with the other two cases, despite having the worse distance visual acuity.

Tests of functional vision, such as the VF-14 are extremely useful tools for identifying problem areas and can provide insightful information about how a person functions in their daily life, even if their vision and other tests appear to show very small clinical defects. Tools such as this provide much information about patients who are very symptomatic, despite performing well on clinical measures of ocular function. Had the VF-14 not been performed on these three patients, there would have been little insight into the problems faced by them in day to day functioning and the assumption that BW is the most severely impaired in terms of functioning may be made, despite the fact that the opposite is true. Functional vision assessment tools are underutilised in the ophthalmic and sometimes rehabilitation setting. The VF-14 is an inexpensive tool which is easily administered and scored in any clinical setting and has the ability to provide extremely useful information about the functional visual capacity of a patient.

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Humphrey Field Analyser

The Humphrey Field Analyser is the most utilised automated perimeter worldwide with over 60 thousand units sold. Since it was first released in 1984, it has undergone a number of advances, the latest of which being the new version of Guided Progression Analysis (GPA).

GPA was originally released in 2004, and was developed to overcome one of the problems with following glaucoma progression using visual fields; namely the difficulty in distinguishing true progression from normal variation. GPA does this by comparing patient tests to a database of tests from glaucoma patients taken from 16 sites on three continents, all of whom were tested once a week for four weeks. This was done because four weeks is not long enough for glaucoma to progress, but the repeated testing was used to measure what normal variation in a glaucoma patient actually is.

GPA then compares each field in a series to a pair of baseline fields and highlights points that have progressed significantly more than what is defined as normal variation. The progression criteria are based on the Early Manifest Glaucoma Trial (EMGT) and to avoid the confounding effects of advancing cataract and cataract surgery, the analysis is based on the Pattern Deviation Plot.

Very recently, GPA has been improved further by adding a new index to measure the rate of progression called the Visual Field Index (VFI). A totally new index to do this was required because none of the current indices were appropriate for the task. The closest was Mean Deviation (MD) which represents the average elevation or depression of a patient's visual field relative to an age-matched reference field, but it is not specific to glaucoma being influenced by other factors including cataracts.

VFI on the other hand was designed specifically with glaucoma in mind by renowned glaucoma researchers Boel Bengtsson and Anders Heijl of Malmo University Hospital in Sweden[1]. In contrast to mean deviation, VFI is based on the pattern deviation plot rather than the total deviation plot which minimises the influence of cataract and it is weighted more towards the central points of the visual field to more accurately reflect ganglion cell loss. Lastly, it is based on a percentage scale whereby 100 per cent is a normal visual field and zero percent is blindness.

The real benefit of VFI comes about when the GPA looks at changes over time using regression trend analysis. The trend analysis plot not only demonstrates the current rate of progression but also extrapolates five years into the future to demonstrate the expected level of vision loss if the current rate of progression continues. Importantly, VFI is plotted against age so that the clinician can make treatment decisions based on patients' life expectancy. Of course, it can also be used for patient education to improve treatment compliance.

Additionally, the VFI trend analysis is very useful to monitor the change in the rate of progression on the initiation of a new treatment regime. The rate of progression can be measured before and after the new treatment to measure its effectiveness.

UNDERSTANDING THE NEW REPORT

The new GPA report fits on a single page which provides and overview of a patients entire visual field history. The print-out can be divided into three sections.

GPA baseline exams

The top section shows all of the relevant information from the two baseline tests including test type, test date, greyscale, pattern deviation plot, MD, PSD, VFI and reliability indices.

VFI plot

In the centre of the report, the VFI Plot graphs the VFI values of all exams included in GPA analysis as a function of the patient's age as well as a linear regression analysis of the VFI over time when appropriate.

To the right of the VFI Plot is the VFI Bar that indicates the patient's current VFI value. In addition, when the results of the regression analysis are displayed, the VFI Bar will also graphically indicate the 3 to 5 year projection of the linear regression line, shown as a broken line.

Current test

The bottom of the print-out shows the current test including greyscale, pattern deviation plot, deviation from baseline plot and progression analysis. The progression analysis uses symbols to indicate significant progression at each point as follows:

A single, solid dot indicates no significant change.

A small open triangle identifies significant progression between the current test and baseline ($p < 0.05$).

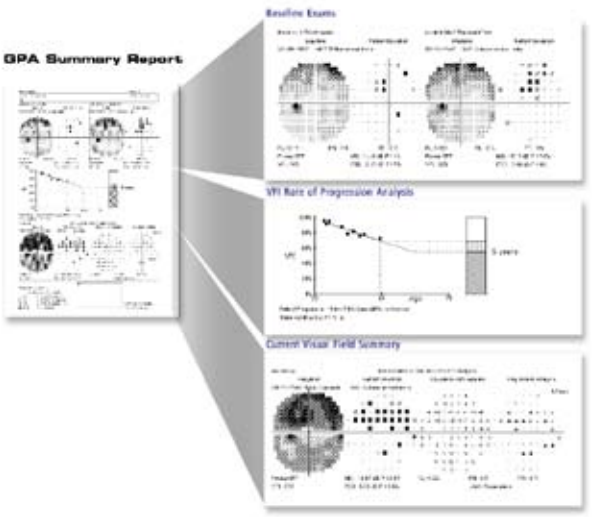
A half-filled triangle indicates significant progression at that point in two consecutive tests.

A solid triangle indicates significant progression at that point in three consecutive tests.

The report is further summarised with plain language alerts. The alert "Possible Progression" appears in the presence of three or more half-filled triangles and the alert "Likely Progression" appears in the presence of three or more solid triangles.

The end result being a useful one-page report that contains all the visual field evidence that a clinician needs to assist in real-life treatment decisions.

1. Bengtsson, B & Heijl, A. A Visual Field Index for Calculation of Glaucoma Rate of Progression. 2008;145:343-353.



Selected Abstracts from the 65th Annual Scientific Conference, held in Melbourne, 23-26 November 2008

OPENING ADDRESS

Hon Prof Barry Jones AO

Hon Prof Barry Owen Jones, AO, is one of Australia's living treasures as well as a writer, broadcaster and former Labour politician. His career has spanned education, science, film, politics, civil liberties, constitutional change and 'the knowledge society'.

Barry represented the federal seat of Lalor between 1977 and 1998 and in the Hawke Government became Australia's longest serving Science Minister (1983-90). He served as National President of the Australian Labour Party 1992-2000 and again 2005-06.

He is the only person to have been elected as a Fellow of all four Australian learned Academies: Technological Sciences and Engineering (FTSE) in 1992, the Humanities (FAHA) in 1993, Science (FAA) in 1996 and Social Sciences (FASSA) in 2003.

His books include Macmillan Dictionary of Biography 1981 and Sleepers Wake! Technology and the Future of Work 1982. His autobiography, A Thinking Reed, was published in 2006.

Barry serves on the boards of CARE Australia, the Macfarlane Burnet Institute, The Centre for Eye Research, Australia and chairs Vision 2020 Australia and the Port Arthur Historic Site Management Authority. He is currently a Professorial Fellow at the University of Melbourne.

A VISION FOR ORTHOPTICS: AN OUTSIDER'S PERSPECTIVE

Stephen Vale
Royal Victorian Eye and Ear Hospital

In 1987, the OAA Council decided that a lecture, to be known as the Patricia Lance Lecture, should be inaugurated in 1988 and that this be presented at the Annual Scientific Conference by an individual prominent in the field of vision science or eye health care. Previously, orthoptists and sometimes ophthalmologists have been invited to deliver this lecture, however, given the current climate of change in eye health care, it was decided to seek and benefit from the perspectives of someone with 'outside' experience who is responsible for guiding the development of our profession and our place in the health sector in which we work. Stephen Vale is the Executive Director of Ambulatory Services at the Royal Victorian Eye & Ear Hospital, and has a close association with the Department & Clinical School of Orthoptics and the services that the hospital's orthoptists provide.

BASE-TO-BASE PRISM TEST : IS IT A VALID ASSESSMENT FOR AMBLYOPIA?

Thong Le[1], Cathy Lewis[1], Connie Koklanis [1,2], Zoran Georgievski[2]
1 Department of Ophthalmology, Royal Children's Hospital
2 Department of Clinical Vision Sciences, La Trobe University

Determining monocular visual acuity is a definitive part of the detection, assessment and management of amblyopia. However, obtaining a quantifiable measurement of vision is not always possible in the paediatric population. Fixation preference upon cover testing is therefore often relied upon to estimate visual function. However, this is generally an option in the presence of manifest strabismus. For patients without manifest strabismus, 'prism-induced tropia testing' can be used. The vertical base-down prism test has been described in the literature with varying reports of sensitivity, most suggesting that the vertical prism test tends to over-diagnose amblyopia.

At the Royal Children's Hospital, the orthoptic team utilises horizontal base-in prisms in front of each eye to determine fixation preference. We know this technique as the "base-to-base prism test" (BBPT), where base-in prisms of 12 Δor 15 Δare held before each eye simultaneously whilst the patient fixates a near target. The patient's fixation preference is then observed. However, to our knowledge no study has investigated the use of horizontally placed prisms in the assessment of fixation. This study aims to investigate the validity of the BBPT in assessing fixation preference in patients. The preliminary results will be presented and discussed.

THE USE OF DISTANCE STEREOACUITY ASSESSMENT IN DETERMINING THE EFFECTIVENESS OF MINUS LENSES IN INTERMITTENT EXOTROPIA

Connie Koklanis[1,2], Karen Zhang[1], Zoran Georgievski[1,3]
1 Department of Clinical Vision Sciences, La Trobe University
2 Department of Ophthalmology, Royal Children's Hospital
3 Department and Clinical School of Orthoptics, Royal Victorian Eye and Ear Hospital

Minus lens treatment has been advocated for intermittent exotropia, X(T), to prevent progression and has been found to be effective in improving the control of the deviation in the distance. However, the effectiveness of this treatment is difficult to ascertain due to the lack of standardised outcome measures. There are no guidelines as to what minus lens strength should be prescribed to achieve the best possible outcome. So, there is a need for an accurate and objective outcome measure.

Distance stereoacuity has been reported to be a reliable assessment of control of X(T). In this study, its role as an outcome measure in the efficacy of minus lens treatment was examined using the Frisby-Davis Distance (FD2) stereotest. The FD2 test is a relatively new real-depth distance stereotest, which provides a reliable measure, and is easily administered and comprehended.

Twenty-four (n=24) patients with X(T)participated. Their distance stereoacuity was tested with the FD2 at baseline, and then with varying minus lens powers (of -1.00, -2.00 and -3.00D) that were tested randomly, as were the distance binocular visual acuity (BVA) and angle of deviation.

The results were that the varying minus lens powers did not have significant effects on the distance stereoacuity and BVA (though as expected, they did influence the angle of deviation). In fact, both measures of binocularity - distance stereoacuity and BVA - tended to diminish with the stronger minus lens power of -3.00D. Participants actually demonstrated difficulty in accommodating through the stronger lenses. The conclusion of this study was that distance stereoacuity (and BVA) cannot be used to determine the optimum minus lens strength that could be used in these patients to reduce the angle of deviation and regain binocularity in the distance. An additional observation was made that stronger lenses should perhaps be avoided to prevent binocular and visual discomfort.

PRACTICE PATTERNS OF ORTHOPTISTS IN THE MANAGEMENT OF INTERMITTENT EXOTROPIA

Danielle Thorburn[1,2,3] Zoran Georgievski[1,4], Konstandina Koklanis[1,3]
1 Department of Clinical Vision Sciences, La Trobe University
2 The Alfred Hospital, Bayside Health
3 The Royal Children's Hospital
4 The Royal Victorian Eye and Ear Hospital

The management of intermittent exotropia (XT) tends to be surrounded by controversies as evident in the literature and little is known about what individual clinicians or our colleagues actually do in practice, except 'a variety of things'. The aim of our wider investigation is to ascertain the surgical practice patterns of ophthalmologists in the treatment of intermittent XT, however, this presentation focuses on the practices or recommendations of orthoptists. Orthoptists work alongside ophthalmologists in the management of strabismus and therefore influence treatment practices, particularly those concerning non-surgical aspects.

A survey was distributed to attendees of the Australian and New Zealand Strabismus Society Meeting in Adelaide 2008, as well as a further small selection of orthoptists working in strabismus practice who did not attend the meeting. The focus of the survey was on assessment that influences surgical management, monitoring and indications for surgery and or orthoptic treatment. Thirty-six orthoptists completed the survey, and the results of this will be reported. The clinical assessment of intermittent XT and the role of orthoptic management will be discussed.

AN UNUSUAL RECOVERY PATTERN OF A DIABETIC IIIRD AND VITH N PALSY.

Liane Wilcox
Eyetreat
Discipline of Orthoptics, Faculty of Health Sciences, University of Sydney

The recovery from an ocular motility nerve palsy caused by a diabetic cranial neuropathy frequently follows a pattern of improvement that can take up to six months. During the recovery phase the patient is encouraged to practice excursions of the affected eye to hasten recovery. Fresnel prisms and/or occlusion are utilized to deal with the resulting diplopia until the ocular motility nerve palsy has recovered.

An interesting presentation of ocular motility nerve palsy in a diabetic type 1 patient highlights the variability that can exists in the recovery of these types of nerve palsies. This patient presented with a 15 year history of a sudden onset R VIth N palsy which appeared to be caused by his uncontrolled diabetes. The R VIth N palsy showed only minor improvement with a large esotropia persisting which required the use of base out prisms to control the resulting diplopia. The recent development of a R IIIrd N palsy from the diabetes required a re-evaluation of this man's prismatic requirements.

More than six months on the IIIrd N palsy has completely recovered and the patient has straight eyes and full ocular motility.

TRACHOMA & INDIGENOUS EYE HEALTH

Professor Hugh R. Taylor AC
Harold Mitchell Chair of Indigenous Eye Health
Melbourne School of Population Health
The University of Melbourne

Although we do not have a clear picture of the current situation in Aboriginal eye health, the data that do exist suggest rates of blindness 10 times that of mainstream and rates of poor vision possibly 24 times as high. Most vision loss in Indigenous communities is either avoidable or preventable with refractive error, cataract, diabetic retinopathy and trachoma as the leading causes. As the first step to develop appropriate and sustainable eye care services, a national survey of Indigenous eye health is being undertaken. This survey has identified 30 sites across the country using a multi-stage random cluster sampling technique. It will examine children aged 5 – 15 years and adults over the age of 40 to determine the frequency of visual impairment and its causes. Additional information will identify the impact of visual impairment in Indigenous communities and other studies are designed to quantify the availability and utilisation of existing eye care services. Amongst these diseases stands trachoma, a national disgrace. We need specific commitment to eliminate blinding trachoma by implementing the SAFE Strategy. The ultimate objective of this work is to change eye care delivery to "close the gap" in eye care for Indigenous Australians.

THE PREVALENCE OF HETEROPHORIA IN A POPULATION-BASED STUDY: A PRELIMINARY REPORT FROM THE SYDNEY PAEDIATRIC EYE DISEASE STUDY (SPEDS)

Shivon Anand
Discipline of Orthoptics, Faculty of Health Sciences, University of Sydney

Method: SPEDS is intending to recruit 3,000 children from 3 randomly selected postcodes. Households are enumerated to determine eligible children and participating families sign an informed consent letter. Each child undergoes a comprehensive eye examination and phoria status is determined by alternate cover test/prism cover test at 33cms and 3-6ms. Children with tropia were excluded from analysis. Cycloplegic refraction (cyclopentolate) was performed by autorefraction (Canon RK-F1 or Retinomax) or by retinoscopy. Ethnicity was determined by self-administered questionnaire and birth parameters ascertained from the child's NSW Personal Health Record. Preliminary data from the first site only is presented here.

Results: In 1324 children aged 5 to 107 months; exophoria was the most prevalent phoria for near and initially increased with age; 54.8% at <12 months to 68.9% at ≥24 to <36 months and stabilising at an average 74% for older children. At distance, in children <12 months, exophoria (55.8%) was more common than orthophoria (43.2%). However, in older children orthophoria was most prevalent, with the proportion progressively increasing with age, rising from 53.9% in the group aged ≥12 to <24 months to 62.7% in children ≥72 months. Conversely, the prevalence of exophoria at distance progressively decreased with age. Overall, esophoria was rare (0.04% at near, 0.02% at distance).

Conclusion: The increasing proportion of orthophoria at distance with age suggests that the process of orthophorisation for distance phoria begins after the age of 12 months.

THE VISUAL OUTCOMES OF PAEDIATRIC OCULAR INJURIES

Catherine Severino
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Purpose: Investigation of outcomes for children with open or closed globe injury.

Methods: Medical records of children <16 yrs presenting at Children's Hospital Westmead with a globe injury during 1999-2007 were examined retrospectively. Excluding those still undergoing recovery or with a pre-existing ocular condition in the injured eye (excluding refractive error), 194 eligible records were identified. Injuries were classified according to The Ocular Trauma Group's1 classifications. Age at time of injury, gender, eye involved, place, mechanism and type of injury, initial visual acuity (VA), management and complications were recorded. Outcome VA was the best-corrected VA measured at the child's last review. Confidence intervals (CI) around proportions are 95% intervals calculated by the Confint program PEPI.

Results: Globe injuries occurred more frequent in males (76.8%) than females (23.2%) and most frequently in children aged 4-5 years (12.4%). 57.2% were closed globe and 42.8% open injuries, the latter resulting in eye removal in 12 cases. Excluding 21 cases without VA recorded at final review, outcome VA was ≥6/12 in 76.4%. Overall VA <6/60 occurred in 20 cases but 75% of those cases had an open globe injury. Conversely, 85.3% of closed globe injuries achieved a VA outcome ≥6/12, a significantly higher proportion than those with an open injury (63.6%, 95% CI 7.25-35.92).

Conclusions: Globe injuries occurred more frequently in males, and the 4-5 year age group. Open injuries had significantly poorer outcomes than closed, both in terms of eye loss and VA.

1 Pieramici DJ, et al., Am J Ophthalmol. 1997 Jun;123(6):820-31.

EYE PLAY SAFE – THE RATIONALE AND DEVELOPMENT OF AN EYE INJURY REDUCTION PROGRAM FOR CHILDREN.

Louise Brennan
Orthoptic Department, Children's Hospital Westmead

Eye injury is a major cause of monocular blindness worldwide. Eye injury as a cause of blindness is incomparable as the majority of cases could be prevented by fairly simple changes in situations and behaviours.

Children commonly suffer eye injuries despite the fact that they are a group that should have high levels of supervision with little access to environments and implements which cause harm.

The benefit of health promotion is recognised and when targeted at paediatric populations can potentially reduce the incidence of preventable eye injury and disease.

The proposed project EYEPLAYSAFE along with a review of the literature and the preliminary findings of a retrospective study (1998-2008) into eye injuries at The Children's Hospital at Westmead will be discussed.

FACTORS ASSOCIATED WITH SURGICAL OUTCOMES FOR RESIDUAL OR RECURRENT ESOTROPIA

Cathy Lewis[1], Thong Le[1], Connie Koklanis[1,2], Zoran Georgievski[2]
[1]Department of Opthamology, Royal Children's Hospital
[2]Department of Clinical Vision Sciences, La Trobe University

Residual or recurrent esotropia is a common occurrence after initial surgical intervention for the correction of infantile or acquired esotropia. Whilst various studies have investigated the rate of re-operation and factors that may predispose patients to the need for further surgery, there is very little research on factors associated with surgical outcomes of re-operation. The aim of this study was to investigate the influence of various clinical, demographic and surgical factors on the outcomes of horizontal reoperation for residual or recurrent esotropia. We retrospectively reviewed the records of patients who underwent a re-operation for esotropia at the Royal Children's Hospital from June 1998 to September 2001. The results of this analysis will be presented.

RESPONSES FROM A VEHICLE SIMULATOR FOR DRIVERS WITH NORMAL VISION AND DRIVERS WITH PERIPHERAL VISION LOSS

Neryla Jolly, Hamish MacDougall, Nathan J Clunas
Discipline of Orthoptics, Faculty of Health Science, University of Sydney.

The current Australian licensing authority standards for drivers require peripheral vision to be within the measurements of 120 degrees across the horizontal meridian and 10 degrees above and below the horizontal meridian. There is some doubt that this standard is an essential requirement to meet safe driver practice 1.

This paper reports on the eye movement patterns and driver responses whilst driving in a simulator (speed maintenance, road position and response to signs and traffic lights) of two groups of drivers, 1 those with full peripheral vision and 2 those with reduced peripheral vision. The eye movements are plotted by a tracking system (developed by Hamish McDougall 2,3) which records eye movements that are synchronized to the driving scene observed by the driver.

Preliminary results indicate that the driver responses and eye movement patterns using the simulator vary. Some drivers with peripheral vision loss demonstrated the same skills as drivers with full visual function other drivers made significant errors The outcome indicates that drivers whose responses on the simulator match the patterns of drivers with full vision are likely to drive on-road with the same capability and level of safety. It further suggests that safe driver behavior is linked to other issues such as attitude and cognitive processing.

COMPRESSIVE LESIONS OF THE VISUAL PATHWAYS

Justin O'Day AM

It is always important in patients who present with reduction in central vision to be able to find those patients who may have a compressive lesion of the visual pathways. A prospective trial of patients with pituitary tumours is presented to demonstrate the variability of visual field presentation and to indicate the circumstances in which compressive lesions need to be excluded.

"I CAN'T SEE OUT THE CORNER OF MY EYE" IDENTIFYING FUNCTIONAL VISION LOSS IN CHILDREN.

Sue Silveira
Orthoptic Department, Children's Hospital Westmead

Functional vision loss is a well known clinical phenomenon in which patients present with visual loss of some description, without accompanying signs of organic disease. Usually patient visual behaviour is inconsistent with the visual capabilities demonstrated during assessment.

This paper will present case studies of paediatric patients who have presented with functional vision loss, with an outline of the examination techniques used to reach this conclusion.

ACCUMAP AND OPTIC NEURITIS

Catherine Mancuso
Department and Clinical School of Orthoptics, Royal Victorian Eye and Ear Hospital

The AccuMap uses multifocal objective perimetry to measure multifocal visual evoked potentials (MFVEP) for testing patients with glaucoma. Due to the long testing time and the expense of the AccuMap the use of this equipment has not been wide spread since its introduction in 2003.

The Save Sight Institute at Sydney University is currently conducting a trial of the AccuMap on patients with Optic Neuritis to investigate the protective role of remyelination in optic neuritis. The Royal Victorian Eye and Ear Hospital is a testing site for this trial.

AccuMap results seem to demonstrate visual field changes in optic neuritis sooner than those of subjective perimetry, and those changes may resolve slower on AccuMap results. Some case studies from the patients recruited

in Melbourne will be presented to highlight the differences between performing Humphrey Visual Fields and AccuMap on patients with Optic Neuritis.

AN ORTHOPTIC INSIGHT INTO GRAVES ORBITOPATHY

Katrina Rogers
Marsden Eye Specialists

Aims: To provide orthoptists with a standardised protocol for assessing patients with Graves orbitopathy.

Methods: A thorough orthoptic and ophthalmic examination is necessary for all patients manifesting ocular complications of Graves Disease. This is essential in determining the presence and severity of the orbitopathy, for monitoring the disease progression and aiding in determining the optimal management plan. Numerous guidelines have been published describing recommended evaluation techniques for the assessment of these patients. These have been amended and added to over time in the attempt to account for all aspects of the disease process. While being varied in their description, generally, these guidelines do not discriminate between the roles of the orthoptist and the ophthalmologist. By combining the four most widely recognised protocols, the Mourits and Rundle clinical activity scores, the NOSPECS and vision inflammation strabismus appearance (VISA) classification systems, we have outlined and identified the main orthoptic duties required in these examinations.

Conclusions: A newly revised, standardised protocol has been established outlining the role of orthoptists in the assessment of patients with Graves orbitopathy. This includes observations, history, visual acuity, intraocular pressures, colour vision, ocular alignment and restrictions, visual fields and fundus photography. Adopting this protocol will ensure that orthoptists examine all aspects of ocular function affected by Graves Disease and encourages a more active participation in patient care.

STROKE AND OCULAR CONDITIONS

Neryla Jolly, Ann Macfarlane
Discipline of Orthoptics, Faculty of Health Sciences, University of Sydney

Stroke is a condition that can affect cortical and brain stem function leading to sensory and motor ocular conditions. Stroke most frequently affects patients in the older age group where ocular conditions are more prevalent. Accurate identification of ocular conditions in a stroke patient and appropriate management strategies can affect their responsiveness to care and recovery. Best practice to achieve patient recovery is vital.

This paper reports on the rate of detection of ocular conditions in an inpatient setting by the orthoptist compared to all health professionals in the unit. It also examines the rate of detection of ocular conditions in existing models of care namely:

1. An inpatient setting where there is an orthoptist
2. An inpatient setting where there is no regular ocular assessment but an eye out patient department exists to which patients can be referred
3. An inpatient setting where there is no regular ocular assessment and patients requiring eye care need to referred out for ocular care.

Management strategies will also be discussed.

Results clearly demonstrated that the presence of an orthoptist in the inpatient stroke unit to assess ocular function enabled greater detection of eye conditions, increased intervention and increased understanding of eye functions. If stroke affected patients are to be assisted with good eye care the inclusion of an orthoptist in the inpatient unit will achieve this goal.

THE PROBLEMS WITH PEDIG

Kristen Saba
Marsden Eye Specialists

A discussion of the PEDIG amblyopia trials, in particular, discussion regarding the problems of applying the research findings in clinical practice and the implications of other amblyopia research results.

THE BIELSCHOWSKY HEAD TILT TEST

Kristen Saba
Marsden Eye Specialists

A discussion of the role of this test in determining the underlying cause of vertical strabismus will be provided. A video presentation of clinical examples will also be included in this talk.

COLOUR VISUAL PROCESSING IN THE MINIATURE BRAIN OF BEES

Adrian G Dyer
Monash University

Studying colour vision allows significant insights into how visual systems operate, but the ability to perceive colour is not unique to primates. Bumblebees and honeybees see ultraviolet, blue and green 'colours', and process information with a brain containing less than 1 million neurons. The bee brain learns colours differently depending upon the specific conditioning procedure, leading to long term colour memory. When bees learn fine colour discrimination tasks then speed accuracy tradeoffs are observed both between individuals, and for groups learning tasks of different degrees of difficulty, suggesting high level 'executive' decision making within the bees' brain for understanding the implications of different problem solving strategies. Between bumblebees and honeybees there appears to a trade off between colour discrimination and visual acuity; suggesting finite limits determined by the number of photons pooled by photoreceptors. The colour discrimination capabilities in honeybees are very similar to that of humans, and colour discrimination is affected by simultaneous or successive viewing conditions. Mapping of bee successive colour discrimination shows a psychometric function that helps explain why plants have evolved distinctively coloured flowers, and the bee brain is able to bind colour information as a predictor of flower temperature, with important implications for what plant species perform best in different environments.

THE WAY WE LOOK AT FACES: VARIATIONS & IMPLICATIONS

Suzane Vassallo[1], Jacinta Douglas[2]
1 Department of Clinical Vision Sciences, La Trobe University
2 School of Human Communication Sciences, La Trobe University

There is little doubt that faces are an important stimulus for our everyday interaction. They afford an understanding of, amongst many things, another's emotional state. Ever thought about what facial features you look at when interpreting a facial expression? It has been shown that ocular fixations which avoid salient facial features – e.g., the eyes, nose and mouth – can preclude accurate labelling of an expression being viewed. There are many cognitive disorders wherein the visual scan path employed in interpreting facial affect is either highly restricted or far-reaching (e.g., in schizophrenia), and in many of these disorders, salient facial features are avoided. The consequence of such misinterpretation is that social interaction can also be impaired. This type of anomaly in the scan path to faces is noted in patients with social phobia, Alzheimer's disease, Huntington's disease and Autism, to name some. Even when the

visual scan path is forcibly restricted in normal individuals, recognising a face becomes impaired (e.g., Henderson, Williams & Falk, 2005). This presentation will provide an overview of the literature to date in the area of facial affect recognition in cognitive disorders. The new direction we are taking with this field of interest will also be discussed.

BONE CONDUCTION TO THE MASTOID BONE – WHAT'S THAT GOT TO DO WITH EYE MOVEMENTS?

Elaine Cornell
Discipline of Orthoptics, Faculty of Health Sciences, University of Sydney

Assessment of utricular function in subjects with vestibular disturbance is complex, especially when a patient is ill or bedridden. Recent research has confirmed that muscle potentials can be recorded from beneath the eye following bone conducted vibration to the skull, and some of this research was presented at the OAA meeting in Perth where we showed that vibration to the top of the forehead at the midline (Fz) produces electrical potentials from beneath the eye that are probably caused by contraction of the inferior oblique muscle.

We have now further developed this research to document the actual eye movements that follow bone conducted vibration to the mastoid bone in healthy subjects, unilaterally and to both mastoids simultaneously. This stimulation typically produces both vertical and horizontal eye movements that are small but reproducible and appear to be related to contraction of the superior oblique muscle/s. These eye movements can help to identify the anatomy and physiology of the vestibulo-cochlear system as well as assist in the diagnosis of vestibular disease.

ELECTRORETINOGRAPHY IN A PAEDIATRIC SETTING – A USEFUL DIAGNOSTIC TOOL

Stephanie Sendelbeck
Orthoptic Department, Children's Hospital Westmead

The Electroretinogram (ERG) records electrical activity of the retina in response to ocular stimulation with light or pattern. The ERG is a test not performed in isolation, but utilised as part of a group of tests which assess visual and retinal function.

Patients are referred to the visual electrophysiology clinic when a diagnosis is uncertain or when the ERG result will help confirm a diagnosis. The benefit of the ERG in providing a diagnosis should not be underestimated and can impact patients and families in terms of genetic counselling, schooling choice, low vision training, and future employment possibilities.

A Retrospective review of patients attending The Children's Hospital at Westmead for ERG assessment over a two year period from 2007-2008 was carried out. Results and cases will be discussed.

WHAT WORKFORCE?

Susan Morgan
Department of Human Services

Over the next four decades in Australia, the number of people aged over 65 will almost double. Within just seven years, about 85 percent of labour market growth will come from people over the age of 45. There will be greater competition in the workforce for younger people as growth in the 'prime age' workforce (26 to 40 years) continues to slow. Generational behaviours will see people changing careers as previous generations have changed jobs and whilst the full effects of the ageing population will not be felt for several decades, there are serious implications for business and industry that choose to be complacent. Recruitment and retention strategies are required that respond to the needs of new, existing and old employees.

WHY BURST AT THE SEAMS? – UTILISING ORTHOPTISTS TO ASSIST IN OUTPATIENT EYE REVIEWS

Zoran Georgievski[1,2], Cathy Brunton[1], Anne Hart-Smith[1], Catherine Mancuso[1], Kylie Robinson[1], Lucette Scuteri[1], Julie-Anne Taylor[1], Robyn Wallace[1]
1 Department and Clinical School of Orthoptics, Royal Victorian Eye and Ear Hospital
2 Department of Clinical Vision Sciences, La Trobe University

Discharge and planning related to working out 'who needs to see the Doctor?' pose challenges to outpatient reforms, which we are keen to advance in the public hospital system and at the Royal Victorian Eye & Ear Hospital. With regard to the provision of eye services, Orthoptists have been under utilised and are now increasingly being leaned on to help. It's perfectly reasonable; and as a profession we should want this.

In order to address unmet appointments for patients who required review after 12 months of their previous attendance to our general eye clinics, RVEEH Outpatients has been trialling a process where patients are followed up in an Orthoptist led review clinic. This involves Orthoptists assessing patients' vision status, reviewing their medical record, and in consultation with each person, developing a suitable care plan for them that involves either-

discharge to their referring GP if and when appropriate, and or plan to engage an optometrist in their care who is more likely to be conveniently located near the patient's home; or

triage back to the general eye clinic so as to receive more timely ophthalmological attention as required.

In all instances, the patient's GP is informed of the suggested care plan so that appropriate multidisciplinary care needs are met.

Owing to increasing demand for appointments by new patients, this Orthoptist led initiative provides a means for patients who have non-acute eye conditions or require infrequent ophthalmological attention to be reviewed in a more timely manner. In turn, it also permits better access for new patients who require care by an Ophthalmologist in the general eye clinics.

An outline and review of this new clinic initiative will be presented and discussion invited.

ORTHOPTIC DIABETIC EYE SCREENING IN THE HOSPITAL SETTING – THE NEXT GENERATION MODEL

Catherine Mancuso[1], Zoran Georgievski[1,2]
1 Department and Clinical School of Orthoptics, Royal Victorian Eye and Ear Hospital
2 Department of Clinical Vision Sciences, La Trobe University

In 1997, the Ophthalmology Department at St Vincent's Hospital Melbourne was closed. This left a large number of diabetic patients without a public hospital point of contact for their routine eye assessment. In response, an Orthoptic led diabetic screening clinic was established with the support of an ophthalmologist as a clinical lead. Due to internal logistical and funding issues, in October 2007 and following 10 years of operation this service was also closed.

With recent initiatives to enhance the scope of Orthoptists' work in this important area, and owing to the close proximity of the Royal Victorian Eye & Ear Hospital and St Vincent's Hospital, a collaborative and 'next generation' model is being developed to assist with diabetic patient eye care in which Orthoptists have a leading role.

The set-up and operation of this diabetic retinopathy screening clinic initiative will be discussed, in particular the involvement of the three stake-holder groups.

DEVELOPMENT OF A FAST TRACK CATARACT CARE MODEL TO IMPROVE ACCESS TO SURGERY

Cathy Brunton, Linda Miln, Zoran Georgievski
Royal Victorian Eye and Ear Hospital

A Fast Track Cataract clinic has been developed at the Royal Victorian Eye & Ear Hospital in alignment with one of the general eye clinics. The intention of this clinic was twofold. Firstly, it would expedite patients who needed or would benefit from cataract surgery, thus reducing waiting times. Secondly, by reducing the number of postoperative review visits, this freed up clinic appointments for other new patients.

Between May 2007 and June 2008, 981 patients with a referral to Outpatients for cataract were seen in the Fast Track Cataract clinic. The clinical path was designed to provide a patient-focused journey through the continuum of care. Each patient's journey was streamlined to consist of one visit preoperatively (Orthoptist assessment including A-scan and Ophthalmologist assessment); surgery performed under topical anaesthetic (eliminating the need to fast); and reduced postoperative follow-up appointments, resulting in improved access to both outpatients and surgery.

The Fast Track Cataract model was evaluated in terms of access to care (reduced waiting times), safety (patients meeting selection criteria, use of topical anaesthetic), outcomes (visual acuity) and patient satisfaction.

The results will be presented and show that this alternate clinical path is an efficient, safe and effective method for many cataract patients to gain access to outpatients and surgery.

ORTHOPTIC INVOLVEMENT IN IMPROVING POSTOPERATIVE CATARACT CARE

Julie-Anne Taylor[1], Cathy Brunton[1], Zoran Georgievski[1,2], Catherine Mancuso[1]
1 Department and Clinical School of Orthoptics, Royal Victorian Eye and Ear Hospital
2 Department of Clinical Vision Sciences, La Trobe University

Worldwide, in recent years, there has been a shift towards reducing the number of postoperative visits for cataract surgery patients. Benchmarking has highlighted that many eye hospitals around the world review patients twice in the period following their cataract surgery.

The Royal Victorian Eye & Ear Hospital is an important training facility for ophthalmology registrars in Australia, and has mostly provided three Doctor reviews – at day 1, week 1 and week 4 postoperatively. We are presently scoping the possibility of reducing visits and or waiting times for patients, which may involve Orthoptists having greater responsibility in their postoperative care.

For the past 6 months, a new postoperative cataract care pathway has been trialled, whereby the patient is reviewed by an Ophthalmologist (or registrar) at day 1, by an Orthoptist and Ophthalmologist at week 1, and by an Orthoptist only at week 4, which includes refraction and prescription of glasses, and appropriate discharge… hopefully.

An outline and review of this new clinic initiative will be presented, the challenges experienced will be shared, and discussion invited.

DEVELOPING A SUSTAINABLE WORKFORCE IN VISION AUSTRALIA.

Jane Ellis, Graeme Craig
Vision Australia

The amalgamation of 7 low vision and blindness agencies in Australia has lead to a review and redevelopment of services designed to meet clients' needs regardless of geographic location, proximity to service centres and specialist staff. Vision Australia recognises the growing need of the community in the area of low vision services and is committed to being a leader in the provision of these services now and in the future. We believe that the best services for clients is through a continuum of care and a life stages approach which can be best facilitated if we are able to meet aspects of the clients vision needs.

Low vision services represents the full range of support and training needs for clients including counselling, equipment, employment, training, education, independent living solutions and orientation and mobility.

While the service may be straight forward and delivered in a short term package it is critical to Vision Australia as it is the largest section of our client group, it will connect this group to Vision Australia and our work and, when done well, it will facilitate ongoing independence in the community for this group of clients. This paper will also outline the challenge for the future of sustainable services with increasing demand and geographic expansion.

THE NEW SECONDARY LEVEL LOW VISION CLINIC AT THE ROYAL VICTORIAN EYE AND EAR HOSPITAL: AN OVERVIEW OF CURRENT DEVELOPMENTS.

Meri Vukicevic[1], Cherylee M. Lane[2] , Elaine Y.H.Wong[2], Barbara Haynes[3], Jill E. Keeffe[2]
1 Department of Clinical Vision Sciences, La Trobe University
2 Centre for Eye Research Australia, University of Melbourne
3 Department and Clinical School of Orthoptics, Royal Victoria Eye and Ear Hospital

A new secondary level low vision clinic was established at the Royal Victorian Eye and Ear Hospital (RVEEH) in Melbourne, with the first patient seen in May 2008. The clinic provides continuum of care for patients of the hospital where such on-site services were unavailable in the past. The model of care includes multi-disciplinary service provision by ophthalmologists, orthoptists, optometrists and low vision advisors. Affiliated organisations include: RVEEH, Centre for Eye Research Australia (CERA), La Trobe University Department of Clinical Vision Sciences, Guide Dogs, Vision Australia, and the Victorian College of Optometry.

The aim of this presentation is to provide a background rationale for the establishment of this low vision clinic, to describe the model of care, and to provide an overview of the patients who have attended the clinic thus far. Case studies will also be presented to illustrate the service and benefits to the patients with low vision.

DEVELOPMENT OF A CLINICAL SCHOOL TO IMPROVE CLINICAL EDUCATION AND THE GRADUATE WORKFORCE IN ORTHOPTICS

Zoran Georgievski[1,2], Kerry Fitzmaurice[1,] Stephen Vale[2]
1 Department of Clinical Vision Sciences, La Trobe University
2 Department and Clinical School of Orthoptics, Royal Victorian Eye and Ear Hospital

Providing quality clinical education to University-based students in allied health is a significant challenge, which doesn't seem to get any easier. This is coupled with the need (and pressure) to provide a ready and capable graduate workforce to help the chronic shortage of allied health practitioners, including Orthoptists, who are needed to provide quality health care.

The education and health sectors have and are recognising that we might have 'moved too far' some years ago, toward higher education, and are responding to this by creating partnerships between universities and health providers to form 'Clinical Schools'. Whilst medicine and dentistry largely retained theirs, nursing has returned to the Clinical School model and allied health professions are following suit. In 2008, La Trobe University and the Royal Victorian Eye & Ear Hospital established a Clinical School of Orthoptics within the hospital.

This presentation will outline the Clinical School of Orthoptics model and some of the benefits gained so far. The need to improve clinical education in Orthoptics in order to further our discipline, and remain relevant in the health landscape by continuing to fulfil our professional obligation of providing high quality, evidence-based eye care services to the public will also be discussed.

ENHANCING CLINICAL PRACTICE

Catherine Devereux
Enhancing Practice Program, Council on the Ageing, Victoria

Currently Cath's role is to manage, (in partnership with Northern Health) the Enhancing Practice Program. The Program is funded by DHS Victoria and delivered to a broad range of clinical and non clinical hospital staff around Victoria. This experiential training program challenges organisational culture as well as staff attitudes and behaviours. Participants are encouraged to practice in a more interdisciplinary, age friendly way.

In this presentation the key principles of Enhancing Practice will be applied to Orthoptic education and practice.

THE VALUE OF CASE CONFERENCING TO ORTHOPTIC STUDENTS' CLINICAL LEARNING

Kylie Robinson[1], Zoran Georgievski[1,2], Catherine Mancuso[1]
1 Department and Clinical School of Orthoptics, Royal Victorian Eye and Ear Hospital
2 Department of Clinical Vision Sciences, La Trobe University

The Royal Victorian Eye & Ear Hospital provides a large proportion (over) of clinical placements to La Trobe University orthoptic students and has the capacity to accept several students at any one time. This allows the rather unique opportunity for students to support and learn from each another, if encouraged to do so.

Case conferencing between students has been introduced this year to those on clinical placement within the Department & Clinical School of Orthoptics. The aim of this initiative was to enhance students' clinical education experience, to augment their learning through each other's individual experiences too, and to ensure better use of clinical placement time over and above their contact time with patients.

Case conferencing is used by clinicians to further patient care and is increasingly being encouraged by health authorities for that purpose. Introducing students to case conferencing teaches them about the importance of this and benefits their clinical learning. Student evaluation of this initiative has been undertaken, is positive and the results will be reported.

DEVELOPMENT OF A BIONIC EYE

Dr Chi Luu
Centre for Eye Research Australia, University of Melbourne

Blindness has a significant impact on individual's quality of life and the social economy. The two major causes of blindness associated with the loss of photoreceptors are retinitis pigmentosa (RP) and age-related macular degeneration (AMD). Worldwide, there are about 1.5 million people suffer from RP, which makes it the leading cause of inherited blindness. Age-related macular degeneration, on the other hand, is the major cause of blindness in Western countries. For example, in Australia, AMD is responsible for 48% of blindness in persons over 40 years of age. At present, there is no effective treatment for most of patients with RP or AMD.

In RP and AMD, the outer retinal neurons (photoreceptors) are profoundly lost, however, the inner retinal neurons are relatively preserved. The bionic eye is developed to allow visual information can be directly delivered to the remaining intact inner retinal neurons bypassing the damaged retinal photoreceptors with the hope to restore useful vision for these patients.

This presentation will provide an introduction to various components of the retinal prosthesis and how the bionic eye works. Preclinical studies on surgical approach for intraretinal implantation, biocompatibility, safety and efficacy of the device will also be presented. The presentation will also highlight the development of the future generation of a high-resolution retinal prosthesis, which is currently being carried out by the Bionic Vision Australia.

RETINAL MICROVASCULAR SIGNS IN ACUTE STROKE

Julie Ewing, Michelle L Baker, Peter J Hand, G Liew, E Rochtchina, TY Wong, P Mitchell, RI Lindley, JJ Wang
Centre for Eye Research Australia, University of Melbourne

Retinal Vascular Imaging Centre, Centre for Eye Research Australia, University of Melbourne It has long been suspected that retinal vessels could give clues about a person's systemic health. The retina is the only place where blood vessels can be viewed non-invasively and retinal vessels are known to have similar features to cerebral vessels. Previous population based studies have shown that certain retinal signs can be a predictor of cardiovascular disease such as stroke. Both the ratio of the width of veins and arteries and presence of retinopathy can predict strokes independently of other risk factors.

The Retinal Microvascular Signs in Acute Stroke study was performed at two Australian sites (Royal Melbourne Hospital and Westmead Hospital, Sydney) between 2004-2007 and enrolled 705 participants. The study aimed to examine retinal vascular signs in acute stroke patients and their relationship to diagnosis and prognosis of different stroke subtypes. Acute stroke patients underwent retinal photography in addition to standard clinical examinations. Photographs were graded for microvascular signs (eg, focal narrowing, opacification), retinopathy and arteriovenous ratio.

Some preliminary results from this study will be discussed including whether different stroke subtypes are more likely to show retinal signs.

MACULAR HOLE

Manisha Ghai
Vision Group

A macular hole is a full-thickness defect of retinal tissue involving the anatomic fovea, thereby affecting central visual acuity. Macular holes have been associated with myriad ocular conditions. This report will describe the clinical observations and assessment of visual function of patients with macular holes. The clinical presentation of macular holes, their differential diagnosis, and patient management are discussed.

Gass's biomicroscopic classification of macular holes and theory of tangential vitreous traction will be discussed in detail. Pseudomacular holes may be mistaken for macular hole lesions, despite careful clinical examination. Careful biomicroscopic examination with a contact lens and use of the Watzke and laser aiming beam tests help to ensure accurate diagnosis. Newer imaging technology, such as optical coherence tomography, is a very useful in diagnosing and management of macular holes. It helps in staging of macular holes that helps in evaluating surgical intervention. It also helps distinguish true macular holes from pseudoholes and provide additional insight into the pathogenesis of this condition. Surgical management with or without pharmacosurgical adjuncts can improve vision in select cases.

DIFFERENTIAL DIAGNOSTIC TIPS FOR OPTIC NEUROPATHIES

Fleur O'Hare
Centre for Eye Research Australia, University of Melbourne

A case report will be presented to highlight the diagnostic dilemma when presented with clear signs of optic neuropathy in the face of unclear aetiology. Careful consideration of family and medical history along with a thorough clinical examination are required to isolate and dismiss other causes for optic nerve pathology such as hereditary, metabolic and compressive lesions. Consideration of the key differential signs and symptoms will be discussed.

CLINICAL MANAGEMENT OF COATS' DISEASE – A CASE STUDY

Christopher R Drowley[1], Melany Gatens[1], Suzane Vassallo[1,2], Justin O'Day[1]
1 Victoria Parade Eye Consultants, St Vincent's Medical Centre,
2 Dept of Clinical Vision Sciences, La Trobe University

Coats' Disease, also known as retinal telangiectasia, is a rare unilateral retinal vascular disease. Those typically affected are males below 20 years of age. If left untreated, severe and permanent vision loss can ensue due to total exudative retinal detachment. Early intervention and close monitoring remains the most effective way to prevent potential vision loss and the progression to a blind, painful eye.

A 15-year-old healthy male presented to our clinic with one-month history of unilateral blurred central vision. Fundal examination revealed a vascular lesion in his peripheral retina, which resulted in lipid deposits forming in the macular region. He was treated and monitored over an 18-month period. He demonstrated a slow though significant resolution of the maculopathy as well as an accompanying improvement in visual acuity. This case will highlight an appropriate management regime applicable to cases who present early. In these instances, a successful visual outcome can result.

BRIEF SYNOPSIS OF ASTIGMATISM PRESENTATION

Matthew Allison
Alcon

Treating Astigmatism has become the new frontier in Cataract Surgery with the advent of improved biometry, astigmatically neutral wounds and Toric implants. This talk intends to inform about this refractive error, it's components, it's prevalence, it's natural course, it's measurement and it's treatment.

THE AUSTRALIAN CHILDHOOD VISION IMPAIRMENT REGISTER PROJECT. (OZ-VISKIDS)

Dr John Ravenscroft
Royal Institute for Deaf and Blind Children

Children with vision impairment require an integrated and tailored service provision that involves health, education, social work, and voluntary organisations. Accurate and current data of the numbers, causes and level of vision impairment and additional disabilities of children with vision impairments are required to plan and develop such a service. Yet it is one of those curious facts that in Australia we still do not know how many children with vision impairments there are. Meeting the needs of children with vision impairment is a very difficult and expensive business and as such surely having a system such as a register which identifies all children with vision impairment is a significant step in the right direction in order to meet the needs of this specialised target group. This paper will describe the major a research project based at the Royal Institute for Deaf and Blind Children to develop and maintain an Australian wide childhood vision impairment register modelled from the success of the Scottish Vision Impairment Scotland Register. The Australian register will collect data about the incidence and prevalence of childhood vision impairment through survey and active surveillance methodology based upon parent led registration. The register as a tool will enable researchers to investigate the cause and prevention of childhood vision impairment; and enable service providers to more accurately plan for the present and future service provision needs of people with vision impairment.

DOES THE USE OF NULL POINT REDUCE VISUAL FATIGUE?

Kerry Fitzmaurice
Department of Clinical Vision Sciences, La Trobe University

Background: Visual fatigue is a commonly reported symptom associated with nystagmus. Visual fatigue has not been widely studied in relation to vision impairment. However the literature indicates a number of factors causing visual fatigue in the fully sighted population which are exacerbated by vision impairment such as, use of VDT's, close viewing distance, length of time doing near work and lighting and or glare.

Methods: Data on visual fatigue in association with vision impairment has been obtained through two studies. Study one a survey of 39 primary and secondary school students. Study two involving a focus group (n= 7) and two in-depth interviews. Outcomes from these studies are related to data obtained from a retrospective analysis of case data from clients who have undertaken null point training at La Trobe University vision rehabilitation clinic.

Results: The most commonly reported pathology across the visual fatigue studies was nystagmus. The commonly reported signs/symptoms of visual fatigue included tiredness, sore eyes, headache, blurred vision and increased nystagmus. The retrospective client data indicated a post training decrease in print size but more importantly a decrease in symptoms of visual fatigue such as sore eyes and headache.

VISION AUSTRALIA - LOW VISION SERVICES

Jane Ellis, Graeme Craig
Vision Australia

Delivery of quality Vision Australia services depends on having adequate numbers of skilled staff working where they are needed. Addressing the current shortfall in the supply and retention of health professionals must be one of our key priorities for the future. A shortage of staff or uneven distribution of staff limits our clients' access to services.

We need to continue to develop a staff support system that values our workforce as a vital resource and treats staff fairly and with respect. Our workforce in the future will be increased, trained, organised and deployed creatively and intelligently to focus on the changing needs of our consumers, their families and the wider population.

"COLOURS AS STIMULI TO INITIATE VISUAL RESPONSE WITH A CHILD WITH CVI": CASE STUDY

Judy Reese, Natalia Dawson
Vision Australia

Children with Cortical Visual Impairment (CVI) provide us with a unique challenge. Whilst there are agreed characteristics shown by many children with CVI, a number of children have indicated unique preferences and dislikes; particularly to colour.

CVI is a vision impairment caused by the interruption of the posterior visual pathways in the cerebrum. This causes an adverse disruption to the clarity of vision and visual perception. Early identification in determining what motivates these children to use their vision is critical for their development. A collaborative assessment between the Early Childhood Educator, Orthoptist and family is essential in formulating an individualised intervention program.

Much of the literature has indicated that colour vision commonly remains intact for children with CVI. So why do they display such a strong preference or dislike to certain colours? A possible explanation is that colour vision is based on the perception of colour. Colour facilitates and integrates visual form, object perception and recognition. Furthermore, colour plays an essential role in scene segmentation and visual memory. We intend to explore the cortical processes of colour perception. We evaluate the theories behind colour cortical processing, the role of the dorsal and ventral pathways and compare the theoretical knowledge with case studies of joint functional vision assessments of a few children with CVI.

"SEEING THE PERSON, NOT THE ABILITY".

Val Tosswill

Marsden Centre, a residential facility located in Western Sydney, is operated by the Department of Ageing, Disability and Home Care (DADHC). The 200 residents at Marsden have a range of disabilities and, since it opened in 1969, the orthoptist has been an important member of the Allied Health team. The residents have both physical and intellectual disabilities and an orthoptic assessment can prove to be quite challenging. A different side of orthoptic practice will be presented with emphasis on the person as a whole, rather than just another eye patient.

LOW VISION CLINICS – WHAT WOULD YOU DO IF YOUR CLOSEST CENTRE WAS A PLANE FLIGHT AWAY?

Rebecca Schostakowski

I was excited to receive my first position as a full time orthoptist in Townsville, at the northern end of Queensland. One of the first similarities conveyed to me, from patients with reduced and low vision, was that there were little to no low vision services available for them nearby to be effective. Patients who requested more services were being referred to low vision centres in Cairns (a 3 hour drive away) or Brisbane (a 16 hour drive or 2 hour flight away). After discussing the situation with the ophthalmologist with whom I work, I was given permission to start developing low vision services from our private rooms. The following presentation describes the modality in which my clinic runs and the organisation required to establish such a clinic. I will discuss also the first few cases referred to the low vision clinic and which components of low vision treatment were used and appeared to receive a better response from the clients.

I firmly believe the work that I am doing at the low vision clinic is benefiting my clients and hope that even though I am only a recent graduate, my experiences will invite other orthoptists to investigate the range of low vision services in their local areas in order to determine any complimentary information or services they could contribute.

GLAUCOMA- FOCUSING ON THE OPTIC NERVE

Jonathan Crowston
Centre for Eye Research Australia, University of Melbourne
Royal Victorian Eye and Ear Hospital

This talk will focus on the clinical optic nerve examination in glaucoma diagnosis and monitoring. We will cover clinical examination techniques, optic nerve imaging and the how optic nerve assessment techniques vary with stage of the disease.

BIOBANK FOR THE NEURODEGENERATIVE DISEASES OF THE AGING EYE

Fleur O'Hare
Centre for Eye Research Australia, University of Melbourne

The purpose of this presentation is to introduce you to the upcoming launch of a major collaborative project to be staged in Australia (CERA, Melbourne Uni, RVEEH) and the United Kingdom (Moorfields Hospital, NIHR Biomedical Research Centre).

Glaucoma and AMD have complex aetiologies that embody a number of disease subgroups with diverse genetic and phenotypic characteristics. These differences are thought to contribute to differences in disease severity and differences in response to treatments. Previous population studies have lacked sufficient number of cases to accurately characterise disease subgroups.

We aim to establish a biobank from a large clinic-based cohort of glaucoma (n=5,000), AMD (n=5,000) and population based controls (n=10,000). Investigations and key outcomes will be highlighted.

32 YEAR FOLLOW UP PRIMARY OPEN ANGLE GLAUCOMA

Rhonda Turnbull

This case study summarises 32 years of follow-up for a patient with Primary Open angle glaucoma.

The patient presented in 1976 aged 38 years for review of moderate myopia, the IOP was 24 and 20 mmHg, c/d ratio recorded as 0.3 ou, this remained unchanged for 20years. He was diagnosed with ocular hypertension.

The first field test was performed in 1994 and not repeated until 3 years later, since then performed regularly. The first Optic disk photography was taken in 1997, and repeated in 2003. Quantitative optic disk assessment (Heidleberg HRT) was performed in 2000 and 2003. Treatment with Xalatan was commenced in 2003 based on subtle disk rim changes evident from the disk photos and the HRT, and IOP reaching 29mmHg OU, pachymetry was recorded for the first time. Successful, uncomplicated bilateral cataract surgery was performed in 2006, treatment changed to Xalacom after postoperative pressure spike. OCT (OPtovue) Optic nerve head and macular ganglion cell complex thickness (GCC) assessments ('08) show congruent GCC and visual field changes, field loss has been stable since 2003.

This case illustrates a long follow up of a myope initially diagnosed with ocular hypertension who subsequently developed optic disk, visual field and inner retinal changes (POAG). The patient has responded well to ocular hypotensive medication. Many advances in the monitoring and treatment of glaucoma have occurred during the 32 years. The early detection of the development of optic disc changes demonstrated the need for treatment, and will aid the assessment of the ongoing response to treatment.

A COMPLEX CASE OF HEAVY-EYE SYNDROME

Sibel Deler
Orthoptic Department, Children's Hospital Westmead

Patients with unilateral or bilateral high myopia may acquire a typical restrictive motility disorder, resulting in esotropia and often hypotropia. This case presents a 10 year old girl with high myopia and an enlarged globe, amblyopia, esotropia and hypotropia. The clinical findings will be presented

THE THERAPEUTIC USE OF REFRACTIVE LASERS

Terry Couper
Melbourne Excimer Laser Group

The use of the Excimer laser is well known for refractive surgery; however the laser is also used for treating some superficial corneal disorders. Phototherapeutic keratectomy (PTK) has been employed as a surgical tool to treat corneal disease for more than 10 years now. The ability to delay or postpone corneal grafting in superficial corneal dystrophies by performing PTK has multiple benefits for the patients and eye banking resources . Recurrent erosions though are the most common indications for PTK. Map-dot-fingerprint dystrophy or basal membrane dystrophy can also be an indication for PTK. Excimer laser surgery can be successfully combined with conventional surgery to remove excessive scar tissue, Salzmann's nodules and very flaky and coarse band keratopathy.

More recently, in conjunction with the femtosecond laser, cornea anterior lamellar grafts, Descemets Stripping Endothelial Keraotaplasty (DSEK) and penetrating keraotaplasty (PK) are also being performed.

This presentation will briefly outline the recent advances in refractive surgery techniques used for therapeutic purposes.

DOES THE WEARING OF GLASSES AFFECT THE PATTERN OF ACTIVITIES OF CHILDREN WITH HYPEROPIC REFRACTIVE ERRORS: THE SYDNEY MYOPIA STUDY (SMS)

Amanda N. French[1], George Burlutsky[2], and Kathryn A. Rose[1]
1 Discipline of Orthoptics, Faculty of Health Sciences, University of Sydney
2 Centre for Vision Research, Department of Ophthalmology, University of Sydney

Aim: Determine if children with hyperopic refractive errors follow a different pattern of everyday activities than children without refractive error.

Methods: Data from the older SMS sample, Year 7 children (aged 12, n=2367) from 21 randomly-selected high schools across Sydney is examined here. Children had a comprehensive eye examination; including cycloplegic auto-refraction (cyclopentolate 1%, Canon RK-F1). A questionnaire completed by parents and children obtained detailed information on daily activities. Hyperopia was defined as a spherical equivalent (SE) refraction of ≥ +2.00 dioptres (D) and refraction of the eye with the best presenting visual acuity was used. Children wearing contact lenses (5) and those with presenting bilateral visual impairment (visual acuity of the best eye ≤6/12) were excluded from analysis.

Results: Overall, 364 (15.8%) children were classified as having a refractive error. Hyperopia was present in 2.5%, and of these 33.9% wore glasses. 155 of the 1925 children without significant refractive error, wore glasses were excluded. Children with hyperopia who wore glasses did not significantly differ from the reference group in a range of outdoor and indoor activities including playing outdoor sport (p=0.1468), watching T.V. and using computers (p=0.5861) or performing near based activities (p=0.7591). Those that did wear glasses, however, spent significantly less time reading books and engaging in close work (mean 19.3hrs per week) than the reference group (mean 23.6 hrs, p=0.0117).

Conclusions: Children with uncorrected hyperopia spend significantly less time in near work activities than children without refractive error or than those with hyperopia who wore glasses.

CAN VISUAL ACUITY SCREEN FOR CLINICALLY SIGNIFICANT REFRACTIVE ERRORS IN TEENAGERS?

J.F. Leone[1A], A. Kifley[1B], S.H. Sharbini[1A], K.A. Rose[1A]
Sydney Childhood Eye Study. [A]Discipline of Orthoptics, [B]Centre for Vision Research, Department of Ophthalmology and Westmead Millennium Institute, [1]University of Sydney, Sydney, Australia.

Purpose: To examine sensitivity and specificity of visual acuity (VA) measures for screening clinically significant refractive errors in a population-based sample of 12-year old school children.

Methods: The Sydney Myopia Study randomly selected 21 Sydney secondary schools. 2353, Year 7 students (mean age 12.7 years) participated (75.3% participation rate). Uncorrected VA was performed monocularly, at 2.44m using a retro-illuminated logMAR chart (CSV1000). Cycloplegic (Cyclopentolate 1%) auto-refraction (Canon RK-F1) was conducted.

Results: Data for both eyes were pooled for a total of 4670 observations. Best VA cut-off to detect any clinically significant refractive errors was 53 letters (6/6-2), with sensitivity and specificity 72.2% and 93.3% respectively. Screening sensitivities and specificities were then examined for individual refractive errors. VA cut-off for myopia was 45 letters (6/9.5) with 97.8%, 97.1% respectively. VA cut-off for hyperopia was 57 letters (6/6+2) with 69.2% and 58.1% respectively. VA cut-off for astigmatism was 55 letters (6/6) with 77.4% and 75.4% respectively. VA appears to be reduced linearly by myopia, but not for hyperopia. VA at the 6/12 cut-off was sensitive for myopia (92%) but not sensitive for hyperopia (17%) and astigmatism (37%). Specificity was sound for all types of refractive errors 98%, 91%, 93% respectively, at this VA level.

Conclusions: In this adolescent group VA ≤6/9.5 can reliably screen for myopia, however, no VA cut-off will reliability screen for hyperopia and astigmatism. Cycloplegic refraction seems to be the only way to reliably detect hyperopic and astigmatic refractive errors.

RISK FACTORS ASSOCIATED WITH STRABISMUS AND AMBLYOPIA IN A POPULATION-BASED SAMPLE OF 6 AND 12-YEAR OLD AUSTRALIAN CHILDREN: THE SYDNEY MYOPIA STUDY (SMS)

Shahrima Sharbini
University of Sydney, Discipline of Orthoptics, Sydney Childhood Study

Methods: The SMS randomly selected 55 schools; 1739 children aged 6 and 2353, aged 12 (75.3% response rate) participated. Cycloplegic autorefraction, LogMAR visual acuity, cover tests (cover/uncover alternate, prism bar) at near and distance were performed. Medical and perinatal histories, household demographics and ethnicity were obtained by questionnaire. SES was classified by home-ownership and ethnicity was assigned when both parents were from the same ethnicity. Low birth-weight was classified as <2500g.

Results: In the 12 year old sample 63 children had strabismus (2.7%); 44.4% esotropic and 69.8% had amblyopia. Overall, children with strabismus did not have a significantly different birth-weight than those without (p=0.4), however, those with exotropia did have a lower mean birth-weight, even after adjusting for ethnicity (p=0.048). Prevalence of exotropia was higher in children from low SES families (OR, 2.1, 95% confidence interval, CI 1.1-3.9). To examine risk factors such as perinatal exposure to maternal smoking, data from both age samples has been combined, 111 children has strabismus (2.7%) and of these 69.8% had amblyopia. Increased prevalence of strabismus was seen in children with a history of maternal smoking (4.7%) than those without exposure (2.5%, OR 2.1, 95% CI 1.0-4.4), after adjusting for a range of factors esotropia remained significant (OR 2.2, 95% CI 1.1-4.7).

Conclusions: Maternal perinatal smoking was associated with an increased prevalence of strabismus, particularly esotropia whilst low SES was associated with a higher prevalence of exotropia.

POSTERS

DRIVING AND DIPLOPIA

Neryla Jolly, Nathan J. Clunas
Discipline of Orthoptics, Faculty of Health Sciences, University of Sydney

Aim: Diplopia in the central field of vision is regarded to be incompatible with safe driving. This paper presents the impact of diplopia on driving performance of clients with diplopia.

Method: The clinical results and driving skills were tested for 7 patients with diplopia. The clinical results included the cause of the diplopia (IV cranial nerve palsy, mechanical injury), measurement of the area of binocular single vision (including the response for slow and fast eye movements).

The driving skills included observation when driving by a team which included the orthoptist, the occupational therapist and a disability trained occupational therapist. The driver skills that were tested included response to the speed and positioning the vehicle, awareness of driving hazards, road signs and road markings. Commentary driving was also tested.

Results: When diplopia was present inside twenty degrees of central fixation, the driving skills were found to be unsafe. When diplopia occurred outside the central 20 degree ring, driver skills were demonstrated to be safe.

Conclusion: Diplopia that exists inside the central 20 degrees of binocular fixation is a good predictor of safe driving skills.

DRIVING WITH VISUAL ACUITY THAT DOES NOT MEET LICENSING STANDARDS

Neryla Jolly
Discipline of Orthoptics, Faculty of Health Sciences, University of Sydney

Background: Visual acuity measurement is a criterion widely used by medical staff and licensing authorities worldwide to assess eligibility to drive. The current standard is 6/12. The purpose of this paper is to report the on road response of 4 drivers with visual acuity of 6/24 to 6/36.

Method: Four male participants with age related macular degeneration in a study of senior drivers were observed in their off and on road performance at the University of Sydney, Australia. The off road assessment included a questionnaire and tests of sensory and motor function. The on road assessment was a set route and included reporting of road signs and markings.

Results: All four drivers demonstrated poor driving performance for a range of skills including sign identification, road positioning, maintenance of speed and late reaction time. Driving instructor intervention was required for two participants, including stopping the car to avoid collision. All drivers failed to retain their license.

Conclusion: Visual Acuity, at a level of 6/24 to 6/36, is incompatible with safe driving practice in senior drivers. Drivers with acuity at this level or less should have their license cancelled.

THE ROLE OF AN ORTHOPTIST INVOLVED IN INTERNATIONAL CLINICAL RESEARCH TRIALS

Mara Giribaldi
Marsden Eye Specialists

Marsden Eye Specialists is one of the leading centres for clinical research trials in Australia predominantly in Aged Related Macular Degeneration amongst other retinal conditions.

The role for orthoptists in our practice includes becoming certified clinicians in visual acuity, retinal photography, fluorescein angiography and ocular coherence tomography (OCT) according to rigid international standards set by drug companies, research and development departments and reading centres conducting this research around the world.

An overview of clinical research trials and orthoptist involvement is explained whilst extrapolating from it important clinical expertise gained in the above mentioned areas of orthoptic/ophthalmic assessments.

INVASION OF THE INTRA CORNEAL STROMAL SEGMENTS (INTACS/KERARINGS)

Naila Mian, Vivien Lee
Vision Eye Institute Chatswood

This poster has information on what Kerarings and Intacs are, indications and contraindications for use as well as the mechanism of how they work. It will also mention a case study.

Named Lectures, Prizes and Awards of the Orthoptic Association of Australia Inc.

THE PATRICIA LANCE LECTURE

1988	Elaine Cornell	(Inaugral)
1989	Alison Pitt	Accommodation deficits in a group of young offenders
1990	Anne Fitzgerald	Five years of tinted lenses for reading disability
1992	Carolyn Calcutt	Untreated early onset esotropia in the visual adult
1993	Judy Seaber	The next fifty years in orthoptics and ocular motility
1995	David Mackey	
1997	Robin Wilkinson	Heredity and Strabismus
1998	Kerry Fitzmaurice	Research: A journey of innovation or rediscovery
1999	Pierre Elmurr	
2005	Kathryn Rose	The Sydney Myopia Study: implications for evidence based practice and public health
2006	Frank Martin	
2008	Stephen Vale	A vision for Orthoptics: An outsider's perspective

THE EMMIE RUSSELL PRIZE

1957	Margaret Kirkland	Aspects of vertical deviation
1959	Marion Carroll	Monocular stimulation in the treatment of amblyopia exanosia
1960	Ann Macfarlane	A study of patients at the Children's Hospital
1961	Ann Macfarlane	A Case history "V' Syndrome
1962	Adrienne Rona	A survey of patients at the Far West Children's Health Scheme, Manly
1963	Madeleine McNess	Case history: right convergence strabismus
1965	Margaret Doyle	Diagnostic pleoptic methods and problems encountered
1966	Gwen Wood	Miotics in practice
1967	Sandra Hudson Shaw	Orthoptics in Genoa
1968	Leslie Stock	Divergent squints with abnormal retinal correspondence
1969	Sandra Kelly	The prognosis in the treatment of eccentric fixation
1970	Barbara Denison	A summary of pleoptic treatment and results
1971	Elaine Cornell	Paradoxical innervation
1972	Neryla Jolly	Reading difficulties
1973	Shayne Brown	Uses of fresnel prisms
1974	Francis Merrick	The use of concave lenses in the management of intermittent divergent squint
1975	Vicki Elliott	Orthoptics and cerebral palsy
1976	Shayne Brown	The challenge of the present
1977	Melinda Binovec	Orthoptic management of the cerebral palsied child
1978	Anne Pettigrew	
1979	Susan Coil	Nystagmus blocking syndrome
1980	Sandra Tait	Foveal abnormalities in ametropic amblyopia
1981	Anne Fitzgerald	Assessment of visual field anomalies using the visually evoked response.
1982	Anne Fitzgerald	Evidence of abnormal optic nerve fibre projection in patients with Dissociated Vertical Deviation: A preliminary report
1983	Cathie Searle	Acquired Brown's syndrome: A case report
	Susan Horne	Acquired Brown's syndrome: A case report
1984	Helen Goodacre	Minus overcorrection: Conservative treatment of intermittent exotropia in the young child
1985	Cathie Searle	The newborn follow up clinic: A preliminary report of ocular anomalies
1988	Katrina Bourne	Current concepts in restrictive eye movements: Duane's retraction syndrome and Brown's syndrome
1989	Lee Adams	An update in genetics for the orthoptist: a brief review of gene mapping
1990	Michelle Galaher	Dynamic Visual Acuity versus Static Visual Acuity: compensatory effect of the VOR
1991	Robert Sparkes	Retinal photographic grading: the orthoptic picture
1992	Rosa Cingiloglu	Visual agnosia: An update on disorders of visual recognition
1993	Zoran Georgievski	The effects of central and peripheral binocular visual field masking on fusional disparity vergence
1994	Rebecca Duyshart	Visual acuity: Area of retinal stimulation
1995-7	Not awarded	

1998	Nathan Clunas	Quantitive analysis of the inner nuclear layer in the retina of the common marmoset callithrix
1999	Anthony Sullivan	The effects of age on saccadis mode to visual, auditory and tactile stimuli
2001	Monica Wright	The complicated diagnosis of cortical vision impairment in children with multiple disabilities
2005	Lisa Jones	Eye Movement Control During the Visual Scanning of Objects
2006	Josie Leone	The prognostic value of the cyclo-swap test in the treatment of amblyopia using atropine
2007	Thong Le	What is the difference between the different types of divergence excess intermittent exotropia
2008	Amanda French	Does the wearing of glasses affect the pattern of activities of children with hyperopic refractive errors: The Sydney Myopia Study (SMS)

PAEDIATRIC ORTHOPTIC AWARD

1999	Valerie Tosswill	Vision impairment in children
2000	Melinda Symniak	
2001	Monica Wright	
2005	Kate Brassington	Amblyopia and reading difficulties
2006	Lindley Leonard	Intermittent exotropia in children and the role of non-surgical therapies
2007	Jodie Leone	Prevelance of heterophoria in Australian school children
2008	Jodie Leone	Can visual acuity screen for clinically significant refractive errors in teenagers

THE MARY WESSON AWARD

1983	Diana Craig (Inaugral)
1986	Neryla Jolly
1989	Not awarded
1991	Kerry Fitzmaurice
1994	Margaret Doyle
1997	Not Awarded
2000	Heather Pettigrew
2004	Ann Macfarlane
2008	Julie Barbour

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1956-7	Mary Carter
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1979-80	Mary Carter
1980-1	Karen Edwards
1981-82	Marion River
1982-3	J Stewart
1983-5	Neryla Jolly
1985-6	Geraldine McConaghy
1986-7	Alison Terrell
1987-9	Margaret Doyle
1989-91	Leonie Collins
1991-3	Anne Fitzgerald
1993-5	Barbara Walsh
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1997-00	Kerry Fitzmaurice
2000-2	Kerry Martin
2002-4	Val Tosswill
2004-6	Julie Barbour
2006-8	Heather Pettigrew
2008-	Zoran Georgievski

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Vol 9 1969	Barbara Dennison & Neryla Heard
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Vol 18 1980-81	Diana Craig
Vol 19 1982	Diana Craig
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Vol 27 1991	Julia Kelly
Vol 28 1992	Julia Kelly
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Vol 30 1994	Alison Pitt
Vol 31 1995	Julie Green
Vol 32 1996	Julie Green
Vol 33 1997-98	Julie Green
Vol 34 1999	Julie Green
Vol 35 2000	Neryla Jolly & Nathan Moss
Vol 36 2001-02	Neryla Jolly & Kathryn Thompson
Vol 37 2003	Neryla Jolly & Kathryn Thompson
Vol 38 2004-05	Neryla Jolly & Kathryn Thompson
Vol 39 2007	Zoran Georgievski & Connie Koklanis
Vol 40 2008	Connie Koklanis & Zoran Georgievski

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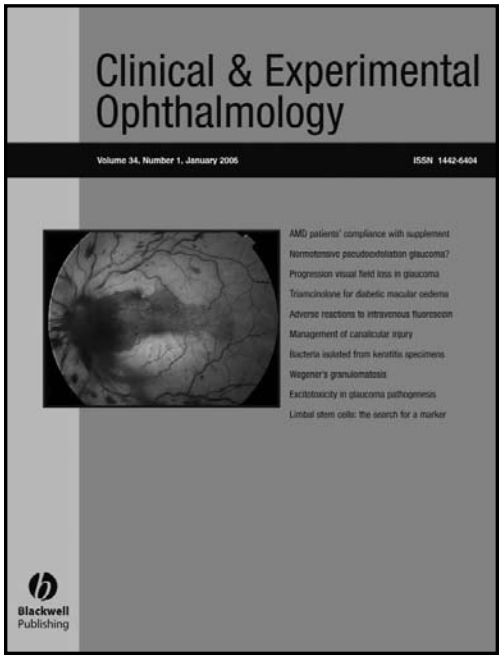

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