Welcome to Bausch and Lomb’s monthly research update.

With our background in clinical ophthalmic research, mainly of the anterior eye, Bausch and Lomb have asked us to produce an independent report of some of the interesting findings coming out of the research journals each month. As a busy practitioner, this should allow you to keep more up-to-date with cutting edge clinical research and allow you to locate the articles when you want to know more about a topic highlighted.

The following key clinical peer reviewed journals are reviewed in this update:

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Professor James Wolfssohn is Professor of Optometry, Deputy Dean of Life and Health Sciences at Aston University. James’ research and teaching interests mainly revolve around intraocular lenses, contact lenses, low vision and the measurement of accommodation. He has published over 100 peer reviewed academic papers, written books on Low Vision and Imaging and has given numerous international presentations. James is also a past President of the British Contact Lens Association.

After graduating with a 1st-class B.Sc. (Hons) degree in Optometry from UMIST in 2004, Amit successfully completed the College of Optometrist’s professional qualification examinations in 2005. Amit has worked as an Optometrist in several clinical capacities, including within the field of corneal refractive surgery. He has recently completed a Ph.D. at the University of Manchester researching optical quality in patients with Keratoconus. He is currently working with Prof. Wolfssohn in a post-doc position at Aston University.
Relationship between RAPD and Visual Fields Defects in Glaucoma Patients

This retrospective study investigated the correlation between the magnitude of relative afferent pupillary defects (RAPD) and various visual field indices measured in patients with glaucomatous optic neuropathy. The results reveal that the prevalence of RAPD was relatively small (25%). The magnitude of RAPD was found to be most strongly correlated with the ‘loss volume’ metric within an eccentricity of 30° (the maximum visual field angle investigated), and most weakly correlated with the central ‘differential luminance sensitivity’ metric. Further investigations using a prospective design and a larger proportion of patients with high density RAPD defects would be useful in fully understanding the relationship between visual field losses and RAPD defects in glaucoma patients.

British Journal of Ophthalmology 96:629-633

Diurnal Variations in Retinal Thickness Using Spectral Domain OCT

The authors investigated diurnal variations in retinal thickness measurements derived from spectral domain optical coherence tomography (SD-OCT). Measurements were made every 2 h over a 10 h period. The results showed that total retinal thickness did not exhibit significant diurnal variation in any of the considered regions (p > 0.05). However, evidence of significant diurnal variation was found in the thickness of the outer retinal layers (p < 0.05), with the most prominent changes observed in the photoreceptor layers at the foveal centre. The photoreceptor inner and outer layer thicknesses exhibited mean amplitude (peak to trough) of daily change of 7 ± 3 µm at the foveal centre. The peak in thickness was typically observed around 1pm. However, this study was conducted in a small number of subjects only (n=12).

Optometry and Vision Science 89:611–619
Variability of Randot Stereoacuity Measurements in Primary School Children

Adler and co-workers determined the test–retest reliability of the Randot stereoacuity test in 139 schoolchildren. The results showed that Randot stereoacuity improved by an average of one plate (one test level) upon repeat testing, but showed little change when tested on a third occasion. Within-subject variability was found to be as high as three test levels on repeat testing. When stereoacuity was categorised as ‘fine’ (≤50 arc-seconds), ‘intermediate’ (>50 but ≤140 arc-seconds) or ‘coarse’ (≥200 arc-seconds), the greatest variability was found among younger children who exhibited ‘intermediate’ or ‘coarse’ stereopsis on the first test. Whereas 91% of children with ‘fine’ stereopsis on the first test exhibited ‘fine’ stereopsis on both subsequent tests. Only around 16% of children with ‘intermediate’ or ‘coarse’ stereoacuity on initial testing exhibited stable test results upon repeat testing. These results suggest that children exhibiting abnormal Randot stereoacuity on initial testing are very likely to exhibit a normal result when retested; therefore, the value of a single, abnormal Randot stereoacuity measurement is questionable.

British Journal of Ophthalmology 96:656-661

Refractive, Optical and Corneal Structures Changes after Suspending RGP Contact Lens Wear for Keratoconus Patients

Jinabhai et al. evaluated changes in refraction, ocular aberrations (Hartmann-Shack method) and corneal structure (Scheimpflug imaging) after suspending rigid gas-permeable (RGP) contact lens wear for 1 week in 15 keratoconus patients. The results showed reductions in both high-contrast (p=0.001) and low-contrast acuity (p=0.002) along with an increase in 3rd-order root mean square aberrations (p=0.008). However, no significant changes in subjective refraction were found (p>0.10). Significant correlations were observed between 3rd-order coma root-mean-square aberrations and the measured high- and low-contrast acuities (p≤0.02). In addition to increases in the anterior surface central corneal powers (p≤0.02), a reduction in central corneal thickness was also found between the 2 visits (p<0.001). These results demonstrate that measurements for designing customised aberration-controlling soft contact lenses will be influenced by the removal of RGP lenses.

Cornea 31:500-508
Characteristics of Keratoconus Patients in Malaysia

Mohd-Ali and co-workers evaluated the demographic profile, refraction, visual acuity (VA), corneal curvature (K) and disease severity of keratoconus patients from a corneal specialist clinic in Malaysia. The prevalence of keratoconus was 1.2%. The mean age of onset was 20.9±5.6 years, comprised of 71.1% of males and 28.9% of females. In terms of severity, 37.6% of patients were graded as stage I (Amsler---Krumeich grading system), 30.1% stage II, 4.4% stage III and 27.8% stage IV at the time of diagnosis. The age of onset, refraction, mean K and VA was found to be similar between genders and ethnicity (p > 0.05). The age of onset was not strongly correlated to the severity of the disease. In summary, this study shows that the majority of keratoconic patients in Malaysia were of Indian and Malay origins. In agreement with previous studies, this report also shows that the condition was manifest at a younger age and was more common in males than females.

Journal of Optometry 5:38-42

Relationship between Fuchs Endothelial Dystrophy and Central Corneal Thickness

This study explored the relationship between Fuch’s endothelial corneal dystrophy (FECD) severity and central corneal thickness (CCT). The authors examined 1610 eyes from a subset of index cases, family members, and unrelated control subjects with normal corneas from the FECD Genetics multicentre Study. The results showed that an increase in CCT occurred with increasing severity of FECD, including at lower FECD grades where clinically observable oedema was not present. In summary, monitoring CCT changes on a regular basis could be a more sensitive measure of disease progression with surgical therapeutic implications.

Archives of Ophthalmology 130:433-439

Intraocular Lens Tilt and Decentration Measured With Scheimpflug Imaging

Kranitz and co-workers compared intraocular lens (IOL) tilt and decentration following circular capsulotomy and the creation of continuous curvilinear capsulorhexis using either a femtosecond laser (LCCC), or performed manually (MCCC). Intraocular lens decentration and tilt were measured using a Scheimpflug camera (Oculus Pentacam) up to 1 year after surgery. The results found that horizontal and vertical tilt were significantly higher in the MCCC group (p=0.007 and p<0.0001 respectively). In conclusion, continuous curvilinear capsulorrhexis created with a femtosecond laser resulted in a more stable refractive result and less IOL tilt and decentration than MCCC.

Journal of Refractive Surgery 28:259-263
Corneal changes following short-term rigid contact lens wear

Tyagi et al. investigated changes in corneal thickness, anterior and posterior corneal topography, corneal refractive power and ocular wavefront aberrations, following the short term use of rigid contact lenses. Four different contact lenses were investigated: two RGP lenses with a diameter of 9.5 mm and 10.5 mm respectively, a PMMA lens with a diameter of 9.5 mm and a soft silicone hydrogel lens. The results showed that the corneal swelling associated with RGP lenses was relatively minor; however on average, there was a small degree of central corneal flattening and a clinically significant hyperopic shift in corneal refractive power after the first day of lens wear. In contrast, the PMMA lenses induced significant corneal swelling resulting in reduced optical performance. It is anticipated that longer term studies are required to reveal how long these corneal changes may persist.

Contact Lens Anterior Eye 35:129-136

Visual Function through Contact Lens–Based Pinhole Systems for Presbyopia

García-Lazaro and co-workers investigated the effects of four different artificial pupil design contact lenses on visual performance in the non-dominant eyes of 22 presbyopic subjects. The results showed that the uncorrected distance acuity and corrected distance acuity ranged from 0.04±0.05 (±1SD) to -0.01±0.04 logMAR and from -0.02±0.05 to -0.05±0.03 logMAR, respectively. Uncorrected near acuity and distance-corrected near acuity ranged from 0.37±0.11 to 0.42±0.20 logMAR, and from 0.35±0.17 to 0.38±0.12 logMAR, respectively. Stereoacuity values for near vision were not found to be significantly different between the 4 pinhole systems (p>0.05). This study shows that soft contact lens apertures provide good distance visual acuity, functional intermediate vision but poor near visual acuity and stereoacuity.

Journal of Cataract and Refractive Surgery 38:858-865
The Effect of Corneal Wavefront Aberrations on Corneal Pseudoaccommodation

This report examined the effect of anterior corneal wavefront aberrations in normal subjects, subjects with prior myopic or hyperopic photorefractive keratectomy (PRK) or laser-assisted in-situ keratomileusis (LASIK) on corneal pseudoaccommodation. Anterior corneal higher-order aberrations were computed from corneal elevation data. Corneal optical image quality was evaluated using the polychromatic modulation transfer function. The results showed that the Zernike terms significantly contributing to depth-of-focus were 4th and 6th order spherical aberration and 4th and 6th order astigmatism in normal corneas, 3rd order vertical coma and 4th order tetrafoil in myopic-PRK corneas, and 3rd order vertical coma and 4th order astigmatism in hyperopic-LASIK/PRK corneas. In summary, depth-of-focus showed a weak to moderate positive correlation with corneal higher-order aberrations (correlation coefficient ranged from 0.30 to 0.58).


Straylight as an Indicator for Cataract Surgery

van der Meulen and colleagues assessed the usefulness of straylight measurements as an indication for cataract surgery. Subjective complaints were recorded using the 39-item National Eye Institute Visual Function Questionnaire (NEI VFQ-39) and a straylight questionnaire. The results found that the mean pre-operative straylight was 1.55 ± 0.29 log(s) and the mean post-operative improvement in straylight was 0.31±0.32 log(s). The pre-operative breakeven point (50% chance of a post-operative improvement) was found to be 1.29 log(s) for straylight. Interestingly, the pre-operative and post-operative questionnaires showed that straylight had almost the same influence as visual acuity on quality of vision, suggesting that straylight measurements should be added to the pre-operative considerations of cataract extraction.

Journal of Cataract and Refractive Surgery 38:840-848
Correcting high magnitudes of corneal astigmatism

The authors examined the stability and efficacy of high-cylinder power AcrySof toric intraocular lenses (IOLs), models SN60T6, SN60T7, SN60T8, and SN60T9 (Alcon Laboratories Inc). Eligible patients had cataract and symmetric corneal astigmatism ≥ -2.25D. Nineteen eyes from 14 patients with a pre-operative corneal astigmatism of 4.00±1.10D were operated on. Three months after surgery the mean residual refractive cylinder was found to be 0.55±0.60D. Before surgery, the mean uncorrected distance visual acuity was 1.30±0.5 logMAR, which improved to 0.11±0.09 logMAR 3 months post-operatively (p<0.0001). These findings suggest that the toric IOLs were stable and effective in correcting high amounts of pre-existing corneal astigmatism at the time of cataract surgery.

*Journal of Refractive Surgery* 28:302-304

Refractive Outcomes of LASEK Using a 213-nm Solid-State Laser

Shah et al. investigated visual and refractive outcomes after conducting laser-assisted sub-epithelial keratectomy (LASEK) performed using a 213 nm solid-state laser for a broad range of refractive errors. The study enrolled 245 eyes (from 134 patients) and evaluated accuracy, safety, efficacy, and stability up to 6 months after surgery. The results showed that at 6 months, 60.4% of eyes were within ±0.25 D of the intended spherical equivalent, 89.4% were within ±0.50 D, and 97.9% were within ±1.00 D. No eye lost 2 or more lines of corrected visual acuity; 95.5% of eyes were unchanged or gained 1 line. In summary, this study demonstrated that LASEK performed using this solid-state laser platform was safe, accurate, and effective for the treatment of myopia, hyperopia, and astigmatism. The benefits of newer solid-state lasers include a higher pulse-to-pulse energy stability, a small spot size (0.6 mm), less sensitive to corneal hydration and the absence of dangerous gas, reducing maintenance costs and noise levels during surgery.

*Journal of Cataract and Refractive Surgery* 38:746-751
Most fascinating research article of the month
Modelling Customised Aberration-Controlling Contact Lenses for Keratoconus Patients

Jinabhai and co-workers compared monochromatic aberrations of keratoconic eyes when uncorrected, corrected with spherically-powered RGP (rigid gas-permeable) contact lenses and corrected using simulations of customised, aberration-controlling soft contact lenses for different magnitudes of rotation (up to 15 degrees) and translation (up to 1 mm) from their ideal position. Three keratoconic patients were evaluated with mild, moderate and severe disease respectively. Residual aberrations were compared using point-spread function images and wavefront aberration maps. The customised lens simulations provided only minor optical improvements over RGP lenses for these keratoconic patients if their movements were constrained within limits, which appear difficult to achieve using current technologies.

*Ophthalmic & Physiological Optics* 32:200–212

Most intriguing journal title of the month
Oral Alcohol Administration Disturbs Tear Film and Ocular Surface

Kim and co-workers investigated if oral alcohol administration disturbed the tear film and ocular surface. Ethanol was administered orally in the form of Soju – a popular Korean drink (19.5% ethanol). Tear osmolarity, ethanol concentration in the tears and serum, Schirmer’s test results, tear film break-up time (TBUT), corneal punctuate erosion, and corneal sensitivity were all evaluated. The results showed that orally administered ethanol was secreted into the tears. Ethanol in the tear film induced tear hyperosmolarity, reduced the TBUT and triggered the development of ocular surface disturbances. These results suggest that excessive alcohol consumption may result in similar tear film changes which could exacerbate the signs and symptoms of patients with ocular surface disease.

*Ophthalmology* 119:965–971

Next report
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