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 Wolffsohn 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. Wolffsohn in a post-doc position at Aston University.
Comparing two diffractive multifocal intraocular lenses (IOLs)

In this comparative case series report, Can and associates compared the clinical outcomes of 32 patients bilaterally implanted with either Acri.LISA 366D (Carl Zeiss Meditec) or AcrivaReviol MFM 611 IOLs (VSY Biotechnologies). The results showed no significant differences in mean spherical equivalent refraction (Acri. LISA: -0.30 ± 0.30 D [SD] and AcrivaReviol: -0.26 ± 0.28 D), binocular measures of mean uncorrected distance ETDRS acuity (+0.10 ± 0.02 vs +0.10 ± 0.01 logMAR respectively) and mean uncorrected near acuity (0.01 ± 0.03 vs 0.00 ± 0.00 logMAR respectively). Equally, the incidence of complications and dysphotopsia symptoms (using the NEI VFQ-25) were not significantly different between groups. However, the authors reported a significant difference in binocular mean uncorrected intermediate visual acuity (0.11 ± 0.10 vs 0.07 ± 0.07 respectively, p=0.04). Can and associates concluded that although both IOLs provided excellent distance and near visual acuity, eyes implanted with the AcrivaReviol IOL gave (slightly) better intermediate vision results.

Assessing the subjective benefits of presbyopic corrections

In this study Buckhurst et al. developed and evaluated a questionnaire to assess the subjective performance of wide ranging presbyopic corrections. Twenty-six questions from past questionnaire were tested on patients implanted with monofocal, multifocal and accommodating IOLs, as well as patients with multifocal contact lenses or varifocal spectacles. The questions were reduced using Rasch analysis, reducing in a 10 item Near Activity Visual Questionnaire (NAVQ). The NAVQ was shown to be valid and repeatable and was able to differentiate between different forms of presbyopia correction. The authors concluded that the NAVQ was a reliable instrument for evaluating the benefit of presbyopic corrections.
van der Linden and co-workers compared the visual and refractive outcomes between a new-generation sectorial addition multifocal IOL (LentisMplus LS-312 – implanted in 90 eyes) and an established diffractive apodised multifocal IOL (ReSTOR SN6AD1 – implanted in 143 eyes). The data analysed included near and distance logMAR acuity, patient satisfaction and dysphotopsia scores recorded at 3, 6 and 12 months after surgery. Three months after treatment, mean uncorrected distance visual acuity was not significantly different between the 2 groups. However, eyes implanted with ReSTOR lenses achieved significantly better uncorrected near visual acuities than eyes implanted with MPlus lenses at both 30 cm (+0.05 ± 0.14 logMAR [SD] vs +0.15 ± 0.08 logMAR; p<0.01) and 40 cm (+0.05 ± 0.14 logMAR vs +0.16 ± 0.21 logMAR; p<0.03). Patients fitted with ReSTOR lenses were more satisfied with their vision (p<0.001), with dissatisfaction likely to be related to a younger age at the time of surgery and male sex (p<0.0001 and p<0.033 respectively).

Shah et al. investigated the rotational stability of AcrySof toric IOLs implanted in 168 eyes of 168 cataract patients. The authors used customised image-analysis software to evaluate lens rotation using recognised landmarks such as the geometrical centre of the IOL, the IOL astigmatic axis markers and the position of episcleral blood vessels (to account for cyclorotation of the eye). Six months after treatment the authors evaluated the effect of axial length on the lens’ rotational stability. The results showed that the median IOL rotation was 0.3° from baseline to 1 week, 1.0° from 1 week to 1 month, 0.2° from 1 to 3 months, and 0.1° from 3 to 6 months. The maximum rotation was found to occur between 1 week and 1 month after surgery. The authors also found a strong correlation between axial length and IOL rotation at 6 months (r = 0.93, p < 0.001), and concluded that toric IOL rotation was greater in eyes with longer axial lengths.
A new posterior chamber phakic intraocular lens (PIOL) for high myopia

Bredow et al. evaluated the visual outcomes achieved with a new PIOL, the EpiLens (Carl Zeiss Meditec). Lenses were fitted into the ciliary sulcus of 48 eyes (of 25 patients) whose mean preoperative manifest refraction spherical equivalent was $-9.90 \pm 2.53$ D. Only two eyes (4.2%) lost one line (Snellen decimal) of best-corrected distance visual acuity (BCDVA) postoperatively, whereas 19 eyes (40%) met and 27 eyes (56%) exceeded the preoperative BCDVA values. The improvement in mean BCDVA was from $+0.83 \pm 0.30$ decimal before surgery, to $+1.03 \pm 0.26$ postoperatively. Interestingly, the results showed no significant difference between the mean postoperative uncorrected distance visual acuity ($+0.85 \pm 0.37$) and preoperative BCDVA ($+0.83 \pm 0.30$) despite the small amount of residual refractive error ($-0.26 \pm 0.84$ D). The authors concluded that this PIOL demonstrated good quality visual outcomes for patients with myopia.

Visual performance of diffractive IOLs: 1-year follow-up

Santhiago and co-workers compared visual outcomes achieved with two multifocal AcrySofReSTOR IOLs, the $+3.00$ D add model (implanted bilaterally for 20 patients) and the $+4.00$ D add model (also implanted bilaterally for 20 patients). Monocular and binocular visual acuities (VA) were measured with a distance correction at intermediate 70, 60, and 50 cm, and near 40 cm. Although no significant differences in distance and near VA were found between the two groups 12 months after surgery, patients fitted with $+3.00$D add lenses performed better than patients fitted with $+4.00$D add lenses at all three intermediate distances evaluated. The authors concluded that fitting lower add-powered AcrySofReSTOR IOLs may lead to improved visual outcomes for intermediate distances ranging between 40 and 70 cm.

Comparing INTACS and Ferrarainstrastomal corneal ring segment (ICRS) implantations

Kaya et al.’s retrospective study compared the topographic and refractive outcomes between 16 eyes implanted with Intacs ICRS (Addition Technology Inc.) and 17 eyes implanted with Ferrara ICRS (Ferrara Ophthalmics Ltd.). The two groups were matched for age, preoperative pupil size and severity of disease. Although both devices significantly reduced mean spherical equivalent refraction, mean maximum keratometric values and significantly improved uncorrected and corrected distance visual acuity, no significant differences were found between the two groups. After surgery, however, eyes implanted with Ferrara ICRS experienced a greater decrease in scotopic contrast sensitivity under glare, which was significantly correlated with pupil diameter.

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Changes in endothelial cell density after implantation of iris-fixated phakic IOLs

Kim et al. investigated changes in endothelial cell density (ECD) in the cornea 1 year after implanting Artisan, iris-fixated phakic IOLs in 25 myopic eyes. The results were compared to data collected over the same time scale from 30 myopic control eyes that had not been implanted with IOLs. The results demonstrated that eyes implanted with these phakic IOLs showed significantly lower ECD measurements in the superior mid-peripheral cornea after surgery. Interestingly, no significant differences were found when comparing the lowest ECD values in any region, the highest ECD values in any region or the ECD values at the central region for before and after surgery. The authors concluded that postoperative ECD measurements should not only be performed at the central cornea, but also in the mid-peripheral corneal locations for patients implanted with phakic IOLs.

*Journal Refractive Surgery 2011* 27 881-886

The effect of Fluorescein dye staining on central corneal thickness measurements

Hirnschall et al. investigated if the presence of fluorescein dye in the tear film caused a clinically relevant change in central corneal thickness (CCT) measured using the Scheimpflug principle (Pentacam HR; Oculus). After baseline measurements of both eyes, a drop of 0.25% fluorescein with 0.50% proxymetacaine (as used for conducting Goldmann applanation tonometry) was instilled and CCT measurements were repeated after 1, 5, 10, 20, 40, and 60 minutes. Thirty eyes of 15 participants were evaluated. The results revealed that the mean CCT (539.1 ± 32.2 µm [SD]) significantly increased, by 46.6 µm ± 11.4 µm, after the instillation of fluorescein (p < 0.01) and was still on average 20 µm higher after 20 minutes. As CCT measurements are critical for corneal refractive surgery, the authors concluded that Scheimpflug imaging should not be performed after instilling sodium fluorescein for assessing corneal staining or for conducting Goldmann applanation tonometry.

*Cornea 2012* 31 18-20

Optic nerve sheath diameter in patients with normal-tension glaucoma

An increase in optic nerve head sheath diameter, or ONSD, is most usually associated with an increase in intracranial pressure. However, in this report Jaggi et al. compared ONSD measurements made using Computerised tomographic cisternography in 18 patients with normal-tension glaucoma (NTG) and 17 age- and sex-matched normal controls subjects. The results showed that mean ONSD measurements were significantly larger in patients with NTG (right: 7.9 ± 0.9 mm [SD]; left: 8.0 ± 1.1 mm) than in the normal control subjects (right: 6.3 ± 0.5 mm; left: 6.1 ± 0.6 mm). The authors postulated that optic nerve sheath thinning and compartmentation may be two possible explanations for the increase in ONSD measured in their NTG patients.

*British Journal of Ophthalmology 2012* 96 53-56
The effectiveness of artificial tears for patients with evaporative dry eye

McCann and co-workers compared the efficacies of sodium hyaluronate, hydroxypropyl methylcellulose (HPMC), and a new ‘oil-in-water’ emulsion eye drop (Emustil) in the management of patients with lipid deficient dry eye. Seventy-five subjects recruited to the study were randomly divided into three groups. Each group was allocated sodium hyaluronate, HPMC, or emulsion eye drops to be used four times daily for a period of 90 days. Parameters were measured at baseline, 30 days, and 90 days. All three groups showed a significant reduction in pre-corneal tear film evaporation coupled with an improvement in ocular symptoms. A significant difference in non-invasive tear break-up time (Hir-Cal grid) was observed in the Emustil and sodium hyaluronate groups but not in the HPMC group. Moreover, there was a significant decrease in tear film osmolarity and corneal epithelial staining in the Emustil group, but not in the sodium hyaluronate or HPMC group. The authors concluded that the improvements in the lipid layer of the tear film occurred as a result of the prolonged use of the emulsion eye drops.

Cornea 2012 31 1-5

Corneal biomechanical properties and their correlations with refractive error

Radhakrishnan and colleagues explored the link between refractive error and the biomechanical properties of the cornea. The authors used the Ocular Response Analyser to measure corneal hysteresis (CH) and the corneal resistance factor (CRF) in 117 participants with spherical equivalent refractive errors ranging between -9.00 and +3.00 D. The data showed a large degree of variation between individual participants. Although no significant correlations were found between CH and refractive error, CRF showed a weak yet significant correlation with spherical equivalent refractive error \( r^2 = 0.04; p = 0.03 \), where myopic subjects displayed higher CRF results than non-myopic participants.

Clinical and Experimental Optometry 2012 95 12-18
Corneal collagen cross-linking for thin corneas

Kymionis et al. investigated the use of corneal collagen cross-linking in eyes with corneal thicknesses less than 400 microns. Fourteen eyes of 12 keratoconic patients were included in this prospective study, where patients were followed-up for a period of 12 months. The Dresden methodology was used to irradiate the cornea with Ultraviolet-A light, following epithelial removal and treatment with Riboflavin drops. The results showed that the mean best-corrected Snellen decimal visual acuity improved from 0.4 ± 0.2 [SD], before treatment, to 0.5 ± 0.2 at 12-months after treatment. Over the same time period, the mean keratometric readings reduced from 51.99 ± 5.6 D to 49.33 ± 4.82 D. Although no intra-operative or post-operative complications were observed in this group of patients, a reduction in the mean endothelial cell density was recorded (pre-treatment = 2733 ±180 cells per mm² [range 2467-3016], 12-month follow-up visit = 2441 ±400 cells per mm² [range 1448-2920]; with p < 0.01). These results indicate that corneal collagen cross-linking causes a significant reduction in endothelial cell density in corneas with thicknesses less than 400 microns.


Most intriguing journal paper title this month...

“Total ocular, anterior corneal and lenticular higher order aberrations in hyperopic, myopic and emmetropic eyes”

Philip et al. evaluated measurements of total ocular aberrations, internal aberrations (posterior corneal and lenticular) and anterior corneal aberrations using a Hartmann-Shack aberrometer and a corneal topographer respectively. A total of 675 adolescents (aged 16.9 ± 0.7 years) were recruited to the study, where all measurements were made following cycloplegia. Patients were divided up into three groups: myopes, emmetropes and hyperopes. Data were analysed for a pupil diameter of 5 mm. The results showed significant differences in spherical aberrations (RMS spherical aberration (4th and 6th order) and the 4th order spherical aberration coefficient) measured between the three groups. Hyperopic eyes (+0.08 ± 0.05 μm [SD]) showed more positive total ocular primary spherical aberration compared to emmetropic (+0.04 ± 0.04 μm) and myopic eyes (low myopia = +0.04 ± 0.05 μm, moderate myopia = +0.03 ± 0.06 μm). No differences were observed for anterior corneal 4th order spherical aberration. Consequently, significantly less negative lenticular 4th order spherical aberration was observed in the hyperopic group (-0.04 ± 0.05 μm) than in the myopic (low myopia = -0.09 ± 0.04 μm, moderate myopia = -0.10 ± 0.05 μm) and emmetropic eyes (-0.08 ± 0.04 μm) (p < 0.05). The authors therefore concluded that hyperopes manifested differences in the characteristics of their crystalline lenses, such as asphericity, curvature and gradient refractive indices, compared to myopic and emmetropic eyes.

Vision Research 2012 52 31-37
Most fascinating research finding of the month...

The prevalence of myopia amongst Chinese school children in Hong Kong was evaluated by Lam and co-workers. The authors compared their results to previously collected data, from two decades earlier, to evaluate any potential changes in prevalence over time. Measurements collected from 2,651 children, between 2005 and 2010, were analysed – mean age 8.9 ± 2 years [1SD]. The prevalence of myopia (i.e. of more than -0.50D) was 18.3% for the 6-year-old group and 61.5% for the 12-year-old group. Average magnitude of spherical equivalent refractive error was -0.06 ± 1.03D at the age of 6 years and -1.67 ± 1.99 D at the age of 12 years. The prevalence of ‘high myopia’ (i.e. of more than -6.00D) was found to be 1.8%, which increased from 0.7% at the age of 6 years, to 3.8% at the age of 12 years. The authors commented that these results were similar to previously reported findings from 1991. Lam et al. therefore concluded that there was no evidence of an increase in the prevalence of myopia amongst Chinese school children over the last twenty years.

“Prevalence of myopia among Hong Kong Chinese schoolchildren: changes over two decades”
Ophthalmic and Physiological Optics 2012 32 17-24

Next report
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