The shape of things to come

Is there a need for another contact lens meeting? Delegates at the new Contact Lens Specialist Symposium would seem to think so, as **Alison Ewbank** discovered

New imaging technologies have led to a major leap forward in our knowledge of the shape of the anterior eye and made it possible to design contact lenses in new and innovative ways.

The first Contact Lens Specialist Symposium (CLSS), held near Heathrow in late September, aimed to bring this knowledge into practice and show practitioners how to use it.

Three keynote speakers, **Eef van der Worp** from The Netherlands, **Patrick Caroline** from the US and **Randy Kojima** from Canada, put together a weekend of lectures. The event was sponsored by No7 Contact Lenses, Contamac and Danish laboratory Con-Lens, and included a small exhibition, reception and dinner.

As van der Worp explained, the lecture content reflected a resurgence of interest in specialist fitting based on a new understanding of the eye's topography. 'We tried to meticulously dissect everything we know today about ocular surface shape – corneal, limbal and anterior scleral shape.

'Then, based on that thinking, the idea was how that shape could be best served with current state-of-the-art contact lenses, from sag-height soft lens fitting, RGPs and multifocal lenses, to orthokeratology, corneal cross-linking, fitting the irregular cornea and a large chunk of scleral lens fitting.

'It was great to share those ideas with representatives from 12 different countries, all fantastic and fanatical contact lens specialists,' he added.

The specialists seemed to agree. The consensus was that the content was practical and relevant, with plenty of tips to take back and apply in practice. The event was also reasonably priced, at £125 to attend the 16 lectures. A lunch time start on the Saturday meant little time out of practice and allowed delegates from outside the UK to fly in that morning.

Patrick Caroline (left) and Eef van der Worp were among the keynote speakers at CLSS 2013

Reaching new heights

Van der Worp (University of Maastricht) opened the programme with a review of anterior ocular shape. Corneal topographers had led to a revolution in speciality contact lens practice leaving the rest of the contact lens industry lagging behind. Practitioners needed to embrace this new technology, he said.

Keratometry only measured 6-7 per cent of the corneal area and only an average curve over the central 3mm, giving no information about shape across the cornea and beyond. Scheimpflug-based devices, profilometry systems and OCT provided maps of corneal elevation and information outside the centre and onto the sclera.

'We have to move away from curvature into height. We're living in the 3D printing technology time so everything is based on height. Curvatures may be obsolete in a couple of years,' he said. Information on the posterior as well as anterior cornea was also useful for diagnostic purposes.

New techniques for mapping beyond the cornea revealed some surprising findings; there was little marked transition from cornea to sclera and in most meridians the transition was straight. When fitting any lens bigger than 15mm, differences between nasal and temporal shape may need to be taken into account since individual eyes varied widely.

Lee Hall (Visioncare Research) described the various topography systems available, from the simple hand-held Klein keratoscope to instruments such as the Eaglet Eye Surface Profiler (ESP), an updated version of the Maastricht Shape Topographer. The ESP measured out to 20mm and provided Ks, shape factor, eccentricity and corneal height data across a range of sags.

Hall used various systems to investigate the variance in soft lens fit that could be predicted from each technique. More peripheral corneal data could be obtained using composite scans with the Medmont ES300 system than from a single scan. New instrumentation offered significantly more data about the central, mid-periphery and peripheral cornea.

Choice of topographer depended on your specialist interest, said Hall. Projection-based systems were useful in refractive surgery practice and OCT for research purposes.

Randy Kojima (Precision Technology and Pacific University, Oregon) offered tips on getting the most out of corneal topography. Always take multiple maps to ensure reproducible data and have the patient fixate a ring or two towards the nose so the Placido is centred to the eye's geometric axis, he advised.

Eccentricity values were useful indicators for lens type and fit, and the scale range was valuable in distinguishing abnormal from normal eyes. Axial maps were best for understanding refraction, power and visual acuity. Tangential maps were better for understanding shape, such as predicting RGP and multifocal lens centration.

Elevation, which mapped the surface of the cornea with reference

to a spherical surface, was useful for revealing what axial and tangential maps could not and for explaining the lens/cornea relationship.

Other uses for topography included mapping over an RGP lens to understand whether it was stable or warping. In orthokeratology, subtractive maps could be used to monitor treatment zone position and refractive changes.

Hall's second presentation shed more light on limbal shape. A study of normal corneoscleral topography using the Medmont ES300 and Visante AS-OCT showed average corneal diameter was 13.42mm, larger than found with other methods, and an average horizontal iris diameter of 11.57mm, significantly smaller than the usual 'white-to-white' measurements.

The study confirmed there was no abrupt change in radius of curvature at the limbus. Age was the main factor influencing corneoscleral profile but there were ethnicity and gender differences too. British Asian eyes showed smaller corneal diameters than other ethnic groups, as did women compared to men.

A further study found that corneoscleral shape profile helped predict soft lens fit when compared with keratometry and videokeratoscopy, accounting for 18-24 per cent of variance in lens tightness, the most reliable indicator of fit. Up to 14 per cent of variance in tightness could be accounted for by the difference between nasal and temporal corneoscleral junction angles. Studies around the world and measurement techniques such as these would be used to produce accurate fitting and comfortable lenses for patients.

Soft lenses revisited

What happens to ocular integrity in soft lens wear and what level of induced change in corneal topography is acceptable, asked Eef van der Worp? In the literature, 0.50D of induced change was considered typical. It was accepted that soft lenses had to be left off before refractive surgery and topography showed it took 28 days for the average cornea to recover.

Considering the sagittal height of the eye might help us better analyse ocular surface shape and benefit soft lens fitting. In order of importance, changing diameter was more effective than eccentricity, which was more effective than base curve in influencing lens sag.

Changing from an 8.3 to an 8.7 base curve lens of equal diameter changed the sagittal height by about 300 microns. But increasing overall diameter from 14mm to 15mm with an 8.3 lens changed the sagittal height by as much as 700-900 microns.

The CLSS audience found the content practical and relevant, with plenty of tips to take back and apply in practice

Base curves were not the best way of describing lens fit and should not be taken too literally, said van der Worp. If anything, they should be termed 'base curve equivalent'. Sag height might be a better starting point to have on packaging. Peripheral shape and material dehydration characteristics were also factors to consider.

Normal ocular sag varied by about 900 microns over a 15mm chord from the shallowest to the largest sagittal height. In large soft lens trial sets, sags varied by a similar amount. But lenses tend to be designed to give peripheral edge lift that was not needed, given the tangential shape of the limbus. Up to 400 microns had to be added to current lens designs to get a fit that looked clinically acceptable.

Van der Worp was now measuring the sagittal height of a range of lenses but other design features were involved; some manufacturers' lenses were monocurve while others were bicurve or aspheric, but this information was rarely provided. Lenses might have the same sag heights but different designs. 'We should know what lens design we're fitting. We don't,' he said.

Quantitative evaluation techniques were also needed. Looking at topographic changes in different zones under soft lenses provided more information about the effects of lens wear over time. For van der Worp, soft lens fitting had not changed much since the 1970s, in fact lens availability and knowledge had decreased. A new system of fitting soft lenses was needed.

Elevation topographic mapping also had an important role to play in the management of keratoconus with corneal cross-linking (CXL). **Nienke Soeters** (University of Utrecht, The Netherlands) reported that CXL was effective and had a low complication rate, although contact lenses still had a role to play.

Ideally, soft lenses should be left out for two weeks and RGPs for a month before treatment. After CXL, patients had to wait one month before fitting with soft or scleral lenses, and three months for RGP or hybrid lenses.

Martin Conway (Contamac) had his own take on developments in contact lens materials. RGPs had seen major advances but practitioners were reluctant to change patients to modern materials. Sclerals were the biggest growth area in the speciality materials business. Uptake of orthokeratology (OK) was 'dismal'. And for the speciality market, silicone hydrogels needed to be lathe-able as well as balancing Dk, modulus and hydrophilic properties.

Controlling myopia

An update from **Pat Caroline** (Pacific University, Oregon) on myopia control was especially useful. Caroline reviewed recent anti-myopia studies, results with various modalities and the mechanism involved. Executive bifocals with base-in prism, low-dose atropine, OK and soft multifocals were promising.

A 50 per cent decrease in the rate of myopic progression was considered clinically significant and reduced the frequency of high myopia >5D by 90 per cent. Instilling 0.01 per cent atropine produced a 59 per cent reduction in axial growth and no effect on accommodation or pupil size. Combined therapies, such as with OK, would play a big role in myopia control.

The average treatment effect from OK studies was 49 per cent and the mechanism was flattening of the 2mm central cornea and increased plus power at the edge of the pupil due to redistribution of the epithelium in the reverse curve area of the lens.

The amount of peripheral plus

power available at 5mm was equal to the central power corrected. 'We can't control it; it's just the way tissue responds to current OK techniques,' he said. The myopia-controlling effect was greater the larger the plus power created in the peripheral optics, suggesting it was the size of the blur circle that had the therapeutic effect.

Partial reduction OK, where highly myopic children >5D were treated as if they were 4D myopes and residual myopia corrected with spectacles, produced a 63 per cent slowing of axial length growth over two years, the greatest achieved with OK to date.

Centre distance multifocal soft contact lenses were the other approach dominating myopia control. CooperVision's dual focus lens, available in Asia, and J&J's Acuvue Bifocal had limited add power but the CooperVision Proclear Multifocal XR with add powers up to 4D produced 'amazing' results. Start with 3D of plus power in the periphery and increase to 3.50D or 4D if myopia continues to progress, he advised.

Since corneal topography over these lenses revealed power profiles almost identical to those created by OK, which technique was best for which child? For OK, the child should be at least a 3D myope so 3D of add power could be induced on the peripheral retina. The soft multifocal performed 'exceptionally well' with lower amounts of myopia.

What advice should delegates give to a parent of a myopic child who came in to their practices the following Monday? 'We need to do some serious soul-searching,' he said. 'Are the data conclusive enough for us to invest in fitting young children with contact lenses. I believe there is a therapeutic effect but each one of us is going to have to come up with that ultimate decision.'

Topography applications

Most of this experienced audience were already using corneal topography, whether in hospital or high-street settings. Randy Kojima's second presentation looked at topography over soft and RGP multifocals to elicit information about fit, centration and power distribution across the pupil. Some soft multifocals tended to show slight temporal decentration due to higher elevation on the nasal side.

Mapping power distribution within the patient's pupil was a powerful tool for comparing different soft multifocal lenses. Measure pupil size and check for decentration, said Kojima. 'We need companies to tell us the diameter of the central zone but we can use topography analysis to tell us.'

With RGP multifocals, where centred optics were even more critical to minimise aberrations, fitting could also be improved using tangential power plots. He went on to describe current approaches to fitting corneal RGPs and the trend towards larger diameter lenses for improved comfort.

Pat Caroline looked at fitting considerations in diseased and irregular eyes where corneal topography can help predict which lens type is likely to be successful. In keratoconus, patients with a height differential >400 microns between superior and inferior cornea would be better candidates for scleral than corneal RGPs.

Piggyback lenses worked well on keratoconic eyes and were underused, said Caroline. Apply a high Dk soft lens with low modulus, such as Acuvue Oasys, and fit an RGP lens over the top. If necessary, increase the plus power of the silicone hydrogel to give extra thickness and then adjust the corneal lens power.

The Flexlens from Xcel-Contacts was a custom piggyback system comprising a soft lens with a circular cut-out to place a GP lens inside. A range of hybrid lenses was also available, including SynergEyes ClearKone, Duette and UltraHealth.

Scleral developments

The final session was devoted to scleral lenses. Randy Kojima categorised them as corneo-scleral (share bearing between cornea and sclera), mini-scleral (≤6mm larger than HVID) and large scleral lenses (>6mm larger than HVID). Most were lathed lenses – moulded, manually ground sclerals were the preserve of a small band of experts – with diameters ≤16.5mm.

Corneal sagittal depth was key to fitting these lenses and K readings 'useless'. Factors controlling the sagittal height of the eye were corneal sag and scleral angle. 'Scleral sag factor' was calculated from the chord of bearing and sagittal height. For a lens with 15mm bearing, a sag of 2,000 microns was a good gauge but not infallible given differences in scleral angle.

Alternatively, ordered sag could be by condition: low sag for post-refractive surgery, medium sag for pellucid marginal degeneration and keratoconus, and high sag for post-keratoplasty, protruding and globic cones.

Pat Caroline described indications in ocular surface disease, for which scleral lenses could be life changing, and for corneal irregularity. A new generation of designs, known as 'tangent angle scleral lenses', was based on revised understanding of scleral shape. The three key ingredients were to clear the corneal apex, clear the limbus and rest on the sclera.

Start with a 4,200 micron sag lens, evaluate the volume of tears underneath by optic section using the thickness of the lens and the tear film, both about 300-350 microns, as a guide. Refract over the lens then order, asking the lab to adjust the tangent angle if more limbal clearance is needed. 'It's that simple and well within the scope of everyone in this room,' said Caroline.

Eef van der Worp touched on corneal physiology in scleral lens wear. With sclerals, oxygen supply was affected by the thick lens and by the clearance, which could act as an extra barrier. A paper in *Contact Lens & Anterior Eye* (35:6) gave predicted maximum central thickness for lens materials of different Dks to avoid hypoxia-induced corneal swelling.

Based on the paper, although a theoretical model, the advice was to use the highest Dk material available, a thinner lens if possible and minimal clearance, both centrally and in the limbal area, but to ensure there was clearance, even after lens settling.

'Milky' vision was a complication of scleral lens wear, requiring the lens to be removed and refilled during the day. Reducing clearance again appeared to be beneficial although lens design issues seemed to play a role as well.

'The beauty of scleral lens fitting is that it's becoming more a science because we can actually measure stuff behind the lens. Unfortunately we don't have that with soft lenses,' he said.

The symposium ended with a wealth of useful tips from **Sophie Taylor-West** (Brighton Contact Lens Clinic) for solving her Top 10 problems with sclerals. Look out for an article based on her presentation in *Contact Lens Monthly*.

● The next Contact Lens Specialist Symposium will be held in Copenhagen in early 2015

USEFUL RESOURCES

- I-site http://netherlens.com/
- Soft Special Edition www.softspecialedition.com
- Scleral Lens Education Society (I&R video) www.sclerallens.org
- Scleral Fitting Guide http://commons.pacificu.edu/mono/4/
- Scleral Lens Case Report Series http://commons.pacificu.edu/mono/5/