New Developments in Refractive Surgery at Moorfields

Bruce Allan  
Consultant Ophthalmic Surgeon  
Service Director for Refractive Surgery  
Moorfields Eye Hospital

In 2010 David Gartry summarized new developments in refractive surgery at Moorfields for the MAA (now the Moorfields Association) as we move towards 2020 an update is appropriate. Much has changed, but the refractive surgery consultant team continues to thrive in greatly improved facilities, and the array of technology at our disposal is stronger than ever. Our new shop window is at www.moorfields-private.co.uk under ‘vision correction’.

We moved into the 3rd and 4th floors of the new Moorfields Private Outpatient Clinic earlier this year. This new refurbishment of the Cayton Street building brings all the ophthalmic subspecialties together under one roof in a greatly improved environment commensurate with the quality of care we have always striven to offer. The synergies were obvious from day one. Having a close connection with the other subspecialties provides access to instant second opinions on cases with complex co-pathology; and bringing us all together on the City Road campus helps make the professional balancing act of combining NHS clinical, research, teaching and management commitments considerably easier.

One of the benefits of embedding refractive surgery within the Trust has been access to an expanded range of therapeutic options for corneal and cataract patients that the femtosecond and excimer laser technology offers.

Moorfields has been one of the early adopters of femtosecond laser assisted cataract surgery, with the Catalys laser system from AMO at both the City Road and St Ann’s sites where the NIHR funded FACT trial of laser assisted cataract surgery versus conventional microsurgery is in the later stages of recruitment. You only have to see a femtosecond laser capsulorhexis once, completed in less than a second and dimensionally perfect, to realize that the technology is here to stay. But as with all new technologies, the balance between cost and benefit has to tip before the femtosecond laser assisted cataract surgery will be disseminated widely.

Moorfields installed the first Schwind Amaris 1050rs excimer laser in the UK in late 2015. At 1050 Hz with autocalibration and seven dimensional tracking, this is the fastest and most accurate excimer laser available. But it is the flexibility of treatment programming and transepithelial ablation that set this laser apart for therapeutic treatments and, in particular, the correction of irregular astigmatism. The years since 2010 have been transformative for keratoconus. We have performed over 2000 corneal collagen cross-linking (CXL) treatments for keratoconus since NHS funding was approved in 2012, and now have a dedicated Early Keratoconus Clinic for monitoring corneal tomography pre and post CXL. CXL is successful in arresting corneal shape deterioration in over 90%
of patients treated, but many keratoconus patients have already lost vision in at least one eye by the time they present. Novel wavefront guided treatment profiles for irregular astigmatism applied in combination with CXL using the Amaris 1050 excimer laser have consistently improved vision in a recent clinical trial at Moorfields, typically bringing patients with early stage visual loss in keratoconus back above the driving standard in spectacles. But does removing tissue (typically around 30 microns maximum treatment depth) impair CXL efficacy? We will not know definitively until the trial cohort has been followed for longer, but emerging two year results look very promising.

In 2010, wavefront guided treatments were often not possible for the patients with highly irregular corneas who most stood to benefit. This is because conventional Hartmann Shack sensors are unable to measure aberrations outside a relatively limited range. Advanced Hartmann Shack sensors (AMO iDesign 2) and pyramidal aberrometry (Schwind Peramis) scanners have arrived in Moorfields in the past two years, enabling us to offer wavefront guided treatments to a wider range of patients here and, in particular, to patients with poor spectacle corrected acuity caused by irregular astigmatism: in keratoconus, post transplantation, post infection, and after complicated or historic refractive surgery.

Alongside our two dedicated refractive laser theatres in the fourth floor laser suite, we commissioned a new laser research room in 2015, giving us the space needed to examine new laser technology without interrupting out established treatment program. First, we looked at SMILE (Small Incision Lenticule Extraction). This is, in essence, flapless LASIK. A specialized femtosecond laser, the Visumax from Carl Zeiss Meditec, is used to define a lens shape beneath the corneal surface, which is then freed by blunt dissection and extracted through a 3mm incision. Whilst the concept is seductive, results were not as good as those for our competing excimer laser systems in the current iteration of SMILE, and we are waiting for substantive technical improvements before looking again. Exciting technical developments on the horizon for the laser research room are a new excimer laser system from AMO to replace the S4 IR, solid state photoablative laser systems, and topographic CXL (PiXL) – a modality we will be exploring in keratoconus patients in a new clinical trial recruiting from later this year.

For higher refractive errors in young patients, ICL implantation has proven to be highly effective, and has bought phakic IOLs into the mainstream at Moorfields. Perhaps counter-intuitively, these soft, sulcus-placed implants have a 500micron hole in the centre of the optic. Ray tracing studies suggest this ‘centreflow’ hole has very little effect optically and, by allowing natural aqueous flow across the anterior lens capsule, may reduce the rate at which cataracts occur as a late complication of implantation.

Newer multifocal intraocular lenses have also had a big impact here. Trifocal optics eliminate the intermediate vision dip associated with bifocal diffractive implants. Trifocality is achieved by using second order diffraction, reducing stray light within the eye and, crucially, dysphotopsia side effects. So it would appear
that the trade off between spectacle freedom and optical side effects, which dominates the discourse on multifocal intraocular lenses, is not a ‘zero sum game’, with improvements in optic design providing gains on both sides of the equation. Aspheric or asymmetric low-addition refractive optics in combination with micromonomovision strategies have also proven very popular, with a pretty even split in the Service between the trifocal and enhanced micromonomovision camps in terms of the default implant choice in refractive lens exchange.

So which of these options is the best and how will we find out? Conventional clinical trials still have a place, particularly in pre-market studies of new techniques. But clinical trials in surgery are expensive and slow. By the time results for post market trials emerge, the technology will often have moved on. The shift to EHR (electronic healthcare record) systems is now gathering in pace, and opportunities for acquisition and analysis of results UK wide are starting to emerge. These national audits are particularly relevant to a fast moving technical field like refractive surgery, which is essentially a numbers game, and will allow us to pick winners and losers quickly from the continuing stream of new refractive laser modalities and implants. Moorfields has recently completed a tender for a new EHR system that will allow us to lead from the front in this megaton audit exercise. These tools will soon be at our fingertips, and it is exciting to contemplate where they will have led us to when the next update is due in 2024!