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4 Swept-Source OCT: A new manner to study retina and choroid
Swept-Source optical coherence tomography (SS-OCT) has revolutionized the capability to study deeper layers of the eye, such as the sclera and choroid, according to Drs Flores-Moreno and Ruiz-Moreno. In this piece, they highlight the benefits of this new technology.

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ReLEx SMILE is a procedure that has become established in a corneal refractive surgery. Using it for low to high myopia seems tempting, considering the advantages that laser surgery without creating a flap has to offer, claims Dr Frank Goes, Jr. In this article, he gives a small literature overview and describes personal results with this procedure.

6 Endpoint Management (EpM)
EpM allows for the control of the laser energy of the Pascal system relative to titration level, which is useful for treatment at low energies, particularly when treating in the macular area. Here, the authors demonstrate the clinical benefit of this management software.

Surgical Instruments
7 Double blade cutters overcome shortcomings of previous cutters for small gauge pars plana vitrectomy
In this clinical report, the properties of double blade vitreous cutters are discussed to highlight how using these instruments can help surgeons to overcome limitations of small gauge vitrectomy.

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State-of-the-Art LED Corneal Topography Guided Accurate Astigmatism Correction in LASIK Surgery

By Dr Ronald A. Krueger, Cleveland Clinic, Cleveland, Ohio, USA

The diagnosis of corneal diseases and characterizations have been implemented significantly in the past years with the development of new technologies and the introduction of new examination procedures in clinical practices. These include topography systems based on the Placido disc, scanning-slit and Scheimpflug-photography technologies and anterior segment optical coherence tomography (OCT) devices, and so on. However, in principle, there is still a lack of accurate and reliable guidance for the management of complicated corneal situations, especially the precise magnitude and axis pinpoint of astigmatism.

Instrument used
The point source color light-emitting diode (LED) topographer (CLT) system — Cassini — is a new topography device that uses 672 LEDs as a stimulator for corneal reflection. The LED pattern has a color code, involving the variation in arrangement of red, yellow and green LEDs. This ensures no mismatch in source and image points. With the axis of astigmatism error less than 4.6º, magnitude error less than 2%, 0 second instantaneous capture and the submicron accuracy error less than 0.8 µm, Cassini is supposed to perform better and with much more accuracy than other instruments currently available in practices.1,2

Objectives
This study aims to evaluate the accuracy and precision of Cassini corneal topographer in measuring the axis of astigmatism and, furthermore, for the pre- and postoperative evaluation and surgical plan for refractive surgery.

Methods
Nineteen eyes were enrolled with varied refractive status undergoing refractive surgery performed by one experienced surgeon from Cleveland Clinic, Ohio, USA. Cassini was used for all the preoperative evaluation along with other topographies. The surgical plan was a complex consideration based on the requirement and conditions. The 30-day postoperative data was also documented.

Results
Cassini is similar, but slightly closer to the nomogram astigmatism magnitude than Pentacam (0.44±0.29 DC vs 0.50±0.29 DC) while in axis there is a significantly greater correlation of the Cassini axis with the final treatment plan (2.25±3.37° vs 9.14±12.74°, p<0.05). Two representative cases are presented here, Table 1 and Table 2. While the surgical plan took Cassini readings as overriding consideration, the results showed 0 DC postoperative in both cases, especially in Case 2 the axis difference between different methods of measurement was more than 30°.

Conclusions
Cassini shows to be more accurate in reconstructing the anterior corneal surface especially the non-rotationally symmetric features in past studies.3 In current studies, it leads to the outstanding postoperative results of Cassini-guided refractive surgeries in particular on the axis of astigmatism. The preliminary data is exciting as it shows that color LED technology provides a reliable tool and stands to pave the way of the future for the cataract refractive platform. Longer period observations and large sample size evaluation is expected later in 2014.

References

Full details of Cassini can be found on page 8.

Table 1: Case 1 20-year-old female under LASIK, pre-op evaluation, surgical plan and post-op data.

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Table 2: Case 2 47-year-old male under LASIK, pre-op evaluation, surgical plan and post-op data.

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Sph: Sphere; Cyl: Cylinder; Ax: Axis; MR: Manifest Refraction; op: Operation; VA: Visual Acuity
Swept-Source OCT: A new manner to study retina and choroid

By Dr Iñaki Flores-Moreno, PhD, and Dr JM Ruiz-Moreno, PhD, Castilla La Mancha University, Spain.

Swept-Source optical coherence tomography (SS-OCT) has revolutionized our capability to study deeper layers of the eye, such as the choroid and sclera. This new technology allows for better resolution imaging when studying chorioretinal diseases as a result of the longer wavelength employed (around 1050 nm, compared to 800 nm used in previous technologies, such as time-domain or spectral-domain (SD)), higher number of scans that can be averaged, higher image capture rate and uniform image quality over depth. The long scan, provided by the Topcon DRI-1 OCT Atlantis (Topcon Corporation, Japan), up to 12 mm, permits simultaneous study of the macular area and the optic nerve.

The effect of ageing in the choroid has been demonstrated to reduce its thickness in healthy patients. Therefore, in theory, a paediatric population should have a full macula choroidal thickness when compared with adults, but our research group demonstrated that paediatrics only have a thicker temporal choroid. The paediatric choroidal profile shows that the thickest part of the choroid is in the temporal region of the macula and this decreases as far as it is measured nearing the optic nerve. There is a decrease in thickness of the temporal area of the macula during the first decade of life until the subject’s twenties, when the choroidal profile adopts a similar one to that of adults, with a thicker choroid in the subfoveal area, decreasing in the temporal region and being thinnest in the nasal area, becoming thinner the closer you get to the optic disc.

SS-OCT is particularly useful in really thick choroids, which can occur in central serous chorioretinopathy, polypoidal choroidal vasculopathy or young and healthy hyperopic patients. In such cases, difficulties in imaging the choroid-scleral interface can be encountered with SD OCT, whereas, SS-OCT allows for a better visualization in thicker choroids.\(^1\)\(^,\)\(^2\) Good correlation has been demonstrated between SD and SS-OCT in healthy patients, although extrapolation of the data should be taken with caution because of the differences in choroidal-scleral interface visualization.\(^2\)

SS-OCT provides excellent images of not only deeper structures but also the vitreoretinal interface.\(^3\) In vivo vitreous anatomy is possible due to SS technology. Bursa premacularis is seen in more than half of a large population with an age range from 5 to 100 years old.\(^3\) There is a positive correlation between the presence of bursa premacularis and the space of Mortegiani\(^3\) and a continuity between the bursa and Mortegiani prepapilar space has been identify with SS-OCT.\(^4\)

To conclude, SS-OCT permits a better visualization of all the posterior pole structures including the vitreous, retina, choroid, sclera and optic disc, which will help ophthalmologists understand the physiopathology of ocular diseases involving these structures and could facilitate the development of new drugs and treatments.

References

Full details of this product can be found on page 8
SMILE — the 3rd generation of laser vision correction after PRK and (Femto-) LASIK

By Dr Frank Goes Jr, Medical director of the Goes Eye Centre, Antwerp, Belgium.

ReLEx SMILE is a procedure that has now become re-established in corneal refractive surgery. In this technique, a small stromal lenticule is created and removed without the necessity of creating a flap.

Since the market introduction and international launch in 2011, more than 80'000 eyes have been treated with this promising technique. Additionally, FDA trials are currently being held and an expansion of the US clinical trial has been approved by the regulatory body.

Using this procedure for low to high myopia seems tempting, considering the numerous advantages that laser surgery without creating a flap has to offer. In this article, a small literature overview as well as personal results will be described.

The results to date
Safety has been shown to be more than acceptable, for example, in a recent study with 1800 eyes,1 only 1.5% of eyes had reduced CDVA at 3 months. However, visual acuity was restored in the long-term after one year, with high patient satisfaction. Postoperative visual outcomes have been studied in a group of Femto-LASIK patients and ReLEx SMILE patients, and the conclusion was that both groups have equal safety, efficacy, predictability and stability.2

As fewer nerve fibres are cut, one of the most important advantages of the technique is a lower induction of dry eye. This has been proven in peer reviewed articles.3,4 The impact on corneal sensation after SMILE and Femto-LASIK has been compared, where SMILE-treated eyes showed less compromised corneal sensation than Femto-LASIK-treated eyes.5

ReLEx FLEX is the forerunner of SMILE, in which an intrastromal lenticule is created as well, but FLEX is performed with a corneal flap-like access. Central and peripheral corneal sensitivity recovery in the early period after SMILE and FLEX have been compared, where the decrease of corneal sensitivity after SMILE was lower and recovery faster when compared with FLEX. The corneal sensitivity of both groups, however, recovered to the original state over time.6

If FLEX is compared to wavefront-guided-LASIK, it has been shown that post-op visual acuity, higher order aberrations (HOA) and corneal asphericity were not statistically significantly different in UDVA and CDVA, there were fewer ocular fourth-order aberrations after FLEX and no differences in third-order HOA.7 For SMILE it has been demonstrated that HOA’s are reduced compared to LASIK.8

Ang et al. compared refractive outcomes after SMILE and LASIK. They proved that refractive outcomes after SMILE are comparable or better than those achieved after LASIK, and that there was a reduction in HOA compared to LASIK. Reduced surgical time and cost, as well as reduced risk of side effects were other advantages of the SMILE-technique.9

Tensile strength after PRK, LASIK and SMILE has been measured in a mathematical model, where the postoperative tensile strength seemed to be considerably higher after SMILE than PRK and LASIK.10

Own experience and results
From September 2012 to February 2014, 253 eyes underwent the SMILE procedure at the Bels lasercentre by Dr F. Goes, Jr. Patients were typically seen at 1 day, 3 weeks, 3 months and 1 year. Retrospective outcomes showed a pre-op spherical equivalent (SEQ) of –5.39 ±1.71 D. At 1 year, post-op SEQ was –0.04 ±0.60 D. No patients lost BCVA more than 1 line. 84% had a refractive outcome ±0.5 D, 91% had an UCVA of 20/25 or better.

Most importantly, at this very moment, we did not have any retreatment after SMILE, a result that is considerably better than the group of patients that underwent Femto-LASIK.

Of course there are some challenges with the technique, e.g., the learning curve. Results after the first 100 eyes seem to be better than in the beginning. The other thing is the slightly slower recovery of vision than patients who underwent Femto-LASIK.

Advantages are numerous: It has a good safety profile, there is less induction of HOA, absence of typical flap related complications, less risk of dry eye, and induction of corneal instability is less. However, there is more — we strongly believe that patients prefer to be treated without flap creation. The fact that a flap has to be cut in one’s eyes is a frightening prospect for some patients, which is not a concern when using SMILE.

Our personal results, in addition to that found in the peer reviewed literature, show significant advantages of SMILE compared to Femto-LASIK or PRK. It combines the advantages and compensates the disadvantages of both, what makes it to the 3rd generation of laser vision correction. We will continue to love and embrace this technique for myopia.

References
8. S. Ganesh, data on file, accepted for ASCRS 2014 Boston, Massachusetts, USA.
9. M. Ang et al., Trials, published online 31 May 2012.

Full details of this offering can be found on page 9
Laser Surgery

Endpoint Management (EpM)

By Prof. Paulo E. Stanga, MD, with Dr Maria Gil-Martinez, Dr Salvador Pastor-Idoate and Dr Claudia Quijano,
University of Manchester, Manchester Royal Hospital and MVR Lab at NIHR/Wellcome Trust Manchester CRF, UK.

The Pascal system (Pattern scanning laser; Topcon Medical Laser Systems Inc., California, USA) allows controlled and safe application of arrays with predetermined parameters. 1

EpM allows for the control of the laser energy relative to titration level. It is particularly beneficial for treatment at low energies with considerable advantage when treating in the macular area, especially when treating close to the fovea. When using EpM the clinician begins by titrating the laser power to a barely visible or subthreshold burn, which will be at 100% of the selected power for the landmark burns. Next, the percentage of the energy to be delivered needs to be selected by the user, usually between 40 to 70%, for the rest of the burns within the array (Figure 1). EpM can be used for both the 532-nm and 577-nm laser wavelengths. It can be especially helpful when performing single-session PRP or single-session combined PRP with macular treatment, as it may reduce the risk of complications. EpM allows the physician to consistently operate within therapeutic range when performing sub-visible treatments.

The clinical benefit of using landmarks at 100% of the laser power to achieve a barely visible burn is that we can easily recognize the treated area. These landmarks are the edge of the arrays of burns and are key to avoid targeting previously treated areas (Figure 2).

Immediately following the application of barely visible or subthreshold laser, the complete array of spots can be mapped using fundus autofluorescence (FAF) imaging. 2 FAF is a non-invasive imaging technique that demonstrates the spatial distribution of the burns and guides re-treatment, to help avoid laser targeting previously treated areas.

EpM makes it easier to obtain highly localized burns with minimal axial and lateral spread. Therefore, minimizing outer retinal damage and reducing pain and most importantly with consequent less retinal–retinal pigment epithelium (RPE) atrophy and less visual field impairment while maintaining the adequate clinical effectiveness.

Healing Response

We have shown through imaging studies in humans a 50% reduction in the diameter of the Pascal burn at one year. 3

Animal histopathology studies have shown a reduction in the width of the zone of retinal damage after laser treatment using barely visible or subthreshold burns secondary to the migration of photoreceptors and RPE cells from the immediate unaffected areas to fill in the gap in the photoreceptor layer. 4

Conclusion

EpM facilitates laser treatment when aiming for a barely visible or subthreshold endpoint.

A barely visible or subthreshold laser treatment endpoint may allow for a healing response to take place at the level of the RPE and photoreceptor layer.

Barely visible or subthreshold endpoint laser induces less tissue damage followed by a healing response while achieving an adequate therapeutic outcome.

References


Prof. Paulo E. Stanga is Professor of Ophthalmology & Retinal Regeneration for the University of Manchester, Consultant Ophthalmologist & Vitreoretinal Surgeon for the Manchester Royal Eye Hospital and Director of the Manchester Vision Regeneration (MVR) Lab at NIHR/Wellcome Trust Manchester CRF.

Further details of this product can be found on page 9.
Double blade cutters overcome shortcomings of previous cutters for small gauge pars plana vitrectomy

Clinical Report, Geuder AG, Heidelberg, Germany.

Since the invention of pars-plana vitrectomy, late in 1969, by Robert Machemer,1 not only the complicity of vitrectomy devices but also of vitreous cutters, as the instrument for this procedure, increased significantly. Combined with small gauge vitrectomy, introduced in 2002 by Gildo Fujii,2 the surgical procedure became more and more gentle.

At the same time, the small dimensions of the instrumentation created new limitations, such as reduced structural integrity, transmission and flow rate, as well as decreased aspiration performance and cutting quality for vitreous cutters.

Today, ophthalmic devices and instruments try to overcome these limits with complicated aspiration pump systems, optimized duty-cycle-management or small ‘oversize’ instruments. Nevertheless, Hagen–Poiseuille law;3 states that the radius is part of the equation in its fourth power and thus, besides the length, is the most limiting factor, and one that cannot be set aside.

With the invention of double blade cutters, some of the above described limitations can be reduced and the performance, especially of small gauge vitreous cutters, benefits from this development. As the blade performs two cuts per procedure step, the vitreous is cut into smaller pieces. These small pieces can be aspirated more easily and thus creates a more consistent flow (Figure 1). It does not set Hagen-Poiseuille aside, but still improves the fluidics. This allows an easier aspiration of the vitreous. Furthermore, the durability of the blades, especially for tougher indications like traumata, organized vitreous, massive vitreous bleeding or luxated lenses, is improved compared to single blade cutters.

Using single blade cutters, the surgeon has to manage two combined surgical parameters, that of aspiration flow and also the cut rate. The higher the cut rate the lower the aspiration flow will be.

This is a result of the cumulated shutter speed of single blade cutters. With double blade cutters, the aspiration window at the vitreous cutter’s distal end is now permanently open, decoupling cut rate from aspiration flow (Figure 2). This now enables a separate control of these parameters, resulting in a fast core vitrectomy and better controllable vitreous shaving.

These two properties of double blade vitreous cutters — its ability to cut vitreous into very small pieces and an improved flow due to the permanently open aspiration window (Figure 3) — sets new standards for small gauge vitrectomy and overcomes the obstacles of single blade cutters.

References

Further details of Geuder’s MACH2 can be found on page 10

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Cassini

**True corneal shape analysis:**
**Essential for toric IOL planning.**

Cassini is a corneal shape analysis device based on color LED technology, which enables superior diagnosis for refractive surgery. Cassini’s unique technology delivers detailed topographic maps and data, which are more reliable than current devices on the market.

The accurate degree and magnitude of astigmatism plays a vital part in the surgical planning process for the correct positioning of a toric IOL. Cassini’s patented measurement principle measures the axis and magnitude of astigmatism precisely, which makes it essential for toric IOL planning and the critical addition to the cataract-refractive platform.

Cassini employs red, green and yellow LEDs that are each positioned in a unique relationship to all four color LED points surrounding it, which gives each one a GPS-like ‘coordinate’. The instrument technology uses the ray-tracing principle to measure the relative position of each point, using the three different colors as ‘triangulation’ points. An elevation increases the distance between points and a depression decreases the distance between points. As Cassini does not use edge detection in its measurement algorithms, smeared or double reflected LEDs cannot skew the results in any direction. This not only allows Cassini to effectively image normal to highly irregular corneas but also to measure those with a poor tear film.

Using this principle as well as instantaneous capture, sub-micron accuracy and LED triangulation, Cassini produces precise measurement of the true degree of astigmatism, excellent precision and data capture and more significant information as well as being easy to use and time-saving.

i-Optics pioneers smart and superior eye diagnostic solutions. Our innovative solutions also include EasyScan zero-dilation retinal imaging and EyePrevent, retinal disease screening service.

i-Optics: See things different. Check out the benefits of True Corneal Shape Analysis at [www.i-optics.com/products/cassini](http://www.i-optics.com/products/cassini)

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Swept Source, the 3rd Generation of OCT

**Imaging the depths of the eye**

Topcon has developed a Swept Source OCT, the 3rd generation of Optical Coherence Tomography. The DRI OCT-1 incorporates Swept Source OCT technology that enhances the visualization of the choroid and, for the first time, enables you to visualize the vitreous, retina and choroid in high resolution on the same scan.

**1050 nm wavelength**

The Topcon DRI OCT-1 uses a wavelength of 1050 nm, which is much higher than the conventional 850 nm used in Spectral Domain-OCT. This increase in wavelength penetrates tissue better, with less scatter. Therefore you are able to image deeper structures better. There is a better penetration of media opacity such as cataract.

**100 000 A-scans/sec**

The scan speed of the Topcon swept-source OCT is twice that of Spectral Domain-OCT devices. The DRI OCT-1 has 100 000 A-scans/second compared with 50 000 A-scans/second in an average SD-OCT, enabling faster acquisition of B-scans.

**Invisible scan lines**

An invisible scanning line due to the 1050 nm wavelength contributes to reduced patient eye motion, enhancing successful rates of scanning and fast examination workflow.

**12 mm Wide scan**

12 mm x 9 mm wide scan captures the macula and disc in the same scan, which is useful for the evaluation of abnormalities observed in a broader area. Furthermore an instant single shot of the 12 mm wide area will reduce patient fatigue and tremendously enhance your examination workflow.

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ReLEx SMILE

Two-and-a-half years after its international launch, the SMILE procedure has become the third generation of laser vision correction after PRK and LASIK. This unique microinvasive refractive method has now been successfully performed on more than 80,000 eyes worldwide.

SMILE stands for Small Incision Lenticule Extraction. It is based on the removal of a tissue disc (called lenticule) instead of tissue ablation, distinguishing it from PRK and (femto-) LASIK. An excimer laser is not required. The refractive lenticule is created in the intact cornea, using the ZEISS VisuMax femtosecond laser system (see Figure 1) and extracted through a small incision. Unlike LASIK, the SMILE procedure is performed without creating a flap.

The SMILE procedure offers several advantages over traditional refractive techniques. Due to the use of femtosecond cutting instead of ablation, refractive correction is not affected by ambient room conditions and corneal hydration and leads, amongst other things, to excellent predictability, also for higher corrections. Due to the absence of a flap, the upper corneal layer and nerve tracts of the cornea remain largely intact. Therefore, the dry eye syndrome is a much rarer side-effect compared with LASIK. Furthermore, the small incision lowers the incidence of infection and epithelial ingrowth, and the healing of the cornea is better.

Nowadays, SMILE is known to be predictable, effective and safe, and is not inferior in any way to LASIK in these three aspects. It is approved for the correction of myopia (up to −10.00 D) and myopic astigmatism (up to −5.00 D) up to an SEQ of −10.00 D and offers major future potential for broadening the indication range.

References

Figure 1: ZEISS VisuMax femtosecond laser.

Endpoint Management; advances in laser technology

Pascal method
Initially developed at Stanford University, the PASCAL Method of Photocoagulation is used to treat a variety of retinal conditions including diabetic retinopathy, age-related macular degeneration and retinal vascular occlusive disease. PASCAL photocoagulators provide significantly improved performance for the physician and an enhanced therapeutic experience for the patient through a family of lasers offered.

PASCAL legacy
PASCAL is the first Pattern Scanning Laser in the world. Since its introduction in 2006, over 750,000 patients have been treated. Over 25 million patterns have been delivered. PASCAL has a strong body of clinical evidence, resulting in more than 20 peer reviewed clinical articles. There are 60 abstract presentations at scientific meetings, highlighting the safety, efficacy and other benefits of PASCAL.

Photo-thermal stimulation Endpoint Management
Endpoint Management (EpM) uses photo-thermal stimulation, which selectively stimulates the RPE without the destruction associated with conventional laser photocoagulation. Using EpM, you can precisely reduce the power and specifically affect RPE cells.

EpM begins with titrating laser power to a hardly visible burn, then the clinician selects the percentage of that energy to be delivered to the treatment locations. Landmark Pattern provide visible indicators of the threatened region.

EpM can be used for PASCAL lasers with 532-nm or 577-nm laser wavelengths for macular treatment and for PRP.

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MACH2 Vitreous Cutter

A new vitreous cutter standard for small gauge pars plana vitrectomy

Improved patient safety and faster vitrectomy — the new MACH2 vitreous cutter fulfills these divergent requirements. The innovative double-blades allow for up to 12000 cuts with megaTRON devices. Together with a permanently open cutting window core vitrectomy is significantly faster compared to single blade cutters. Also in vitreous base shaving the new vitreous cutter shows significant advantages. The high cutting rate releases immediately tractions to the retina. The continuous flow enables direct control of the aspiration. Complex duty-cycle-management is not necessary, so that even existing surgical devices can be used. Not only for standard vitrectomy — but also for complex pathologies as, for example, luxated lenses — the new vitreous cutter is predestined due to its holdability and obviates the need for posterior use of ultrasound. Vitreous haemorrhages are aspirated with minimum traction, the retina is protected in case of ablatio. The MACH2 from Geuder is the first single-use double-blade vitreous cutter.

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3D Optical Coherence Tomography

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