Femto-LASIK: Blade-Free, Flap-Free, Excimer-Free Technique
Tuesday, April 21, 2015: 10:00 AM-11:30 AM
Room 7B (San Diego Convention Center)

Small Incision Lenticule Extraction (SMILE) is the latest development in the long evolution of keratolenticular refractive procedure. The refractive lenticule cut is performed using the state of the art Femtosecond laser and the lenticule is extracted through small corneal incision without the need for corneal flap creation, making this procedure bladefree , flapfree and minimally invasive. During the last 2 years, this most advanced LASIK procedure has become clinically available in Europe and Asia as an alternative to LASIK for correction of myopia. In the United States, the procedure is currently undergoing clinical trials for approval by the US Food and Drug Administration.

Course Description

Course will discuss a blade-free, flap-free femto-Lasik system. Refractive lenticule Extraction–small-incision lenticule extraction eliminates the need for the excimer laser because the entire procedure is performed using a femtosecond laser. No corneal flap is created; the entire surgery is performed through a small incision of 2 clock hours through which a corneal lenticule according to the patient's refractive error, is extracted. The course will discuss the various options, advantages, and challenges of this procedure and results and complications through video-based presentations.

INSTRUCTOR
Mahipal S. Sachdev, MD

FACULTY Rupal S. Shah, MD , Chitra R. Ramamurthy, MD , Sri Ganesh MS, DNB
and Ramamurthy Dandapani, MD

Course schedule:

DR CHITRA RAMAMURTHY: Basics of ReLEx-Smile: The technology behind it

DR D RAMAMURTHY Surgical technique- TIPS AND TRICKS

DR SRI GANESH: Handling complications and Newer Innovations

DR RUPAL SHAH : Why is SMILE better?

DR MAHIPAL SACHDEV: Making it work for your patient and yourself

Dr. Rupal Shah, 46, completed her medical studies at Topiwala National Medical College, Bombay University in 1992. She completed her M.S. (Master of Surgery) degree in Ophthalmology. Subsequently, Dr. Shah went to Germany for training in refractive surgery. She then, along with her husband, set up New Vision Laser Centers in Mumbai in 1994. At that time, this was the 5th laser refractive surgery center in India, and the first in West India. In 2012, New Vision Laser Centers joined hands with the New Delhi based Centre for Sight, to set up India's largest LASIK network.

Subsequently, New Vision Laser Centers-CFS have more than 23 laser centers all over India. In addition, Centre for Sight operates more than 20 Superspeciality Eye Clinics all over India. Dr. Rupal Shah is the Group Medical Director of New Vision Laser Centers-CFS. In this capacity she oversees the work of more than 100 ophthalmologists.

Dr. Rupal Shah is also extremely active in training ophthalmologists to perform LASIK. She has personally performed laser surgery at more than 30 centers all over the world, and more than a 1000 ophthalmologists have performed their first LASIK procedures under her guidance and mentorship.

In 2008, Dr. Rupal Shah became a medical consultant to Carl Zeiss Meditec for refractive lasers. In this capacity, she has performed the highest number of ReLEx procedures in the world. She has also helped to improve the results of the procedure, even before its commercial launch in 2010.

She has a strong academic interest, and is a member of the American Society of Cataract and Refractive Surgery, and the International Society of Refractive Surgery (American Academy of Ophthalmology), besides other local ophthalmic associations. She regularly presents papers at various meetings all over the world and India.

In 2008, Dr. Rupal Shah was awarded the President's Gold Medal by the Indian Intraocular Lens and Refractive Surgery Society, which was presented to her by the Governor of Maharashtra. In 2010-

FACULTY PROFILE

Dr. Mahipal Singh Sachdev, MD
Chairman and Medical Director, Centre for Sight
Specialisation – Cataract, Cornea & Ocular Surface, Refractive surgery and LASIK

Dr. Mahipal S Sachdev, Chairman & Medical Director of Centre for Sight group of eye hospitals is a renowned Ophthalmic Surgeon who is recognized for his expertise in the areas of Cataract, Cornea & Refractive surgery, both nationally and internationally. Dr. Sachdev pursued his medical education at the graduate and post graduate level at the prestigious All India Institute of Medical Sciences (AIIMS). He later joined AIIMS as a Faculty Member. In the year 1989, he completed Fellowship at Georgetown University, Washington DC, USA.

Dr. Sachdev is a pioneer in propagating the technique of Phacoemulsification (stitchless cataract surgery) in India. He is also widely credited to pioneer the newest generation Femtosecond laser cataract surgery and has done the maximum number of femtocataract surgeries in India. He is a leading refractive surgeon proficient in wide variety of laser vision correction procedures from LASIK to PRK, ICL and SMILE. He is also one of the fastest surgeons to reach the milestone of performing 1000 ReLEx SMILE procedures in the country.

Dr. Sachdev has been honored with Padmashri award for his excellence in the field of Medicine by Hon. President of India Dr A P J Abdul Kalam on March 23, 2007. He has received numerous awards and distinctions in India and abroad for his contribution to Ophthalmology. He has been recognized globally with fellowships and scholarships from the "Fifth International Symposium on Immunopathology"- Japan, "International Society of Eye Research", "Research to Prevent Blindness", New York, "Fisons award by the Contact Lens Association of Ophthalmologists", USA amongst others. In India he has won the "A C Aggrawal Memorial Trophy", "Col. Ranagachary Certificate", "Krishna Sohan Singh Trophy", "Dr Ishwar Chand Silver Jubilee Award" to name a few.

Dr. Sachdev has been active in imparting surgical training to the ophthalmic community. He has conducted several live surgery demonstrations in the remotest locations of India to teach and popularize the technique of suture less cataract surgery. He was the secretary of the Delhi Ophthalmological Society from 1993 to 1995 and the president for the same society in the year 2006. Under his stewardship the society was transformed from a small local body to an organization of national eminence which influences the practice of Ophthalmology in a major way both in India and abroad. Dr Mahipal was also the Chairman of the scientific committee of the All India Ophthalmological Society from 1996 to 1999, a distinction that he achieved at the young age

of 38. He is presently the Chairman of Intraocular Implant & Refractive Society (India) and was earlier its Secretary. He has also been elected International Member by American Academy of Ophthalmology. In the year 1999 he was inducted to the Summit Autonomous Society USA, which recognizes leading refractive surgeons globally. He is the Indian representative at the Asia Refractive Council and has been active in various international symposia and conferences, where he has conducted courses and presented over 150 papers. He has over 100 published articles to his credit. He has also been the editor of the Delhi Journal of Ophthalmology and Visiscan and was on the editorial board of various journals like the Indian Journal of Ophthalmology, Indian Pediatrics, ophthalmology World Report etc. He has authored over 5 books in the area of eye surgery including the first book on Phaco by any Indian. These books are today referred to by every budding Ophthalmologist.

2011, Dr. Rupal Shah was awarded the Shiv Prasad Hardia award for the best paper in Refractive Surgery by the All India Ophthalmological Society (AIOS). She was also awarded Best Paper of Session by the the American Society of Cataract and Refractive Surgery (ASCRS).

Dr. Rupal Shah has several publications, both in peer reviewed journals, like the Journal of Cataract and Refractive Surgery, and in Industry publications like Ocular Surgery News, Ophthalmological Times, CRS-Today, and Ophthalmology World Report. In 2010, Ophthalmology World Report nominated her as one of the 25 women who have had the most impact on Indian Ophthalmology.

Dr. Rupal Shah practices in both Vadodara and Mumbai. She has two children.

Dr. Sri Ganesh, M.B.B.S., M.S., D.N.B
Chairman & Managing Director of Nethradhama Hospital Pvt Ltd.
Managing Trustee Shraddha Eye Care Trust (R),,
Padmanabha Nagar Bangalore.

H.O.D. Phaco Refractive department
Dr. Sri Ganesh received his basic medical education in Bangalore, Karnataka, and completed his postgraduate training in ophthalmology at Regional Institute of Ophthalmology, Minto Ophthalmic Hospital, Bangalore Medical College, Bangalore. He completed DNB in 1999. He was a observer fellow in Phacoemulsification and Lasik- Sheppard Eye Centre, LV, Nevada, USA
Biotech Park

Awards

- Best Post-Graduate Paper awarded in State Ophthalmic Conference, 1992.
- Best Scientific exhibit award in state Ophthalmic Conference, 1992
- Muller Paten Award for Best paper for Initial study of phakic IOL's : by President & Office bearers of KOS at 23rd KOS conference , Belgaum , 2003.
- Dr. Krishna Murthy 1st Best Paper Award : Cyclotorsion and its significance in wavefront lasik by the President and Office Bearers of Karnataka Ophthalmic Society, at 24th Karanataka Ophthalmology Conference in Bangalore – 2004.
- Basheer Mekri best Paper Award for : Our initial experience of Toric ICL's by President and Office bearers of Karnataka Ophthalmic society at the 25th KOS conference held at Bangalore – 2006.

IIRSI Gold Medal - Scientific Committee of Indian Intraocular Implant and Refractive Society.

Priti Natarajan Award - For Good Eye Clinic Eye Hospital Administration - AIOC 2011.

BOA GOLD MEDAL 2011 - For Outstanding Service in Ophthalmology at BOA conference held at Mumbai on 27th August 2011.

Toric ICL & ICL AWARD 2011 - For performing over 1000 ICL's and over 500 Toric ICL's, the largest series in India. He recieved this award at the STAAR Surgical 8th International Visian ICL Experts

Symposium, held at ESCRS, Vienna on 16th September 2011.

Main interests are Cataract (Phacoemulsification) and Refractive surgery. Has been in the forefront of newer technologies for Phacoemulsification and Refractive Surgeries.
Also conducted the trials for ICE Software for Phacoemulsification in Sovereign and Signature systems and is on the Global Strategic Advisory Board for Abbott Medical Optics..

He has performed Live Surgical demonstrations for phacoemulsification and LASIK, guest's lectures, paper/video presentations for various conferences and journals.

Dr. Ramamurthy Dandapani

MBBS from JIPMER, Pondicherry

M.D.OPHTHALMOLOGY from R.P. Center, AIIMS, New Delhi

DNB in Ophthalmology

Fellowship in VITREORETINAL SURGERY

He was the **CHAIRMAN – SCIENTIFIC COMMITTEE** of All India Ophthalmological Society (AIOS) which is an association of 12,000 Ophthalmologists from all over India. As Chairman he was in charge of coordinating the entire scientific activities of the association from 2008 – 2011. He has further been reelected unanimously for a period of 3 years from 2011 to 2014.

Chairman of:

THE EYE FOUNDATION, which has branches in Coimbatore, Tirupur and Ooty.

The three centers together employ 18 full time consultants and 40 Optometrists with total staff strength of about 240. State of the art treatment for all sub specialties is provided in these three centres.

Is a trustee of **NETHRA JYOTHI TRUST**, a registered charitable trust through which all the eye camps and other charitable activities are carried out. Exclusive charitable eye hospitals named "RAJALAKSHMI NETHRALAYA" at Coimbatore & "THIRUMURTHY NETHRALAYA" at Tirupur are run by the trust to take care of economically weaker sections of the society.

Has been trained at premier eye centers around the world in USA, UK, Germany, Netherlands, Switzerland, Australia, Hong Kong and Singapore.

Has been a guest speaker and invited faculty at various State, Regional, National and International level meetings and seminars and has performed live surgeries at many centers throughout the country and abroad

Is a member of the Cornea Sub Committee for ICO (International Council of Ophthalmology).

Is a Co-Chairman of the Scientific Committee for the APAO (Asia Pacific Academy of Ophthalmology) meet to be held at Seoul in 2012 & Hyderabad in 2013.

Is a Reviewer of Indian Journal of Ophthalmology & EYE.

Has chaired sessions, presented papers, guest lectures, INSTRUCTION COURSES and performed LIVE SURGERIES at:

ASCRS meetings at San Diego, Boston, Washington, Chicago and San Francisco.

ESCRS (European Society of Cataract and Refractive Surgery) meet at Paris, London, Stockholm, Berlin and Barcelona.

Australian Society of Cataract and Refractive surgery (AUSCRS) meet at CAIRNS, AUSTRALIA.

Asia Pacific Academy of Ophthalmology meetings at Manila, Bangkok, Singapore, Bali, Busan & New Delhi.

ICL Experts meet at Stockholm and Barcelona.

European Society of Ophthalmology (SOE) meeting at Amsterdam.

Has performed live surgeries & conducted courses at APAO Bali & Beijing.

Chaired a symposium at the Russian Society of Ophthalmologists meeting at S. Fyodorov Eye Microsurgery institute at Moscow.

AWARDS:

DR.C.B.BHASKARAN Ophthalmic oration award by IMA Tamil Nadu.

Dr. P. Siva Reddy Gold Medal Oration award by Andhra Pradesh Ophthalmic Society.

Retina Foundation Oration award by Gujarat Ophthalmic Society.

Dr. Mahendra Mishra Oration award by Orissa Ophthalmic Society.

Dr. T. Agarwal gold medal by Intraocular Implant & Refractive Society, India

Captain Kiran Sen memorial lecture awarded by Regional Institute of Ophthalmology, Kolkata.

Dr. Vinod Arora oration awarded by Uttarkhand State Ophthalmological Society

Gold Medal from Bombay Ophthalmic Association.

Dr. Joseph Gnanadhickam Memorial Gold medal oration award by Tamilnadu Ophthalmic Association.

Dr. Ishwarchandra oration award by Vidharba Ophthalmological Society.

Dr. V.M.Albal Oration Award by Deccan Ophthalmological Society.

Prof B.P. Kashyap Oration Award, EIZOC 2011

Distinguished Service Award at APAO 2012, Busan.

Dr. Chitra Ramamurthy

Medical Director of
a) The EYE FOUNDATION at R.S.Puram in Coimbatore
b) The EYE FOUNDATION at Harvey road in Tirupur
c) LASIK CENTRE (India) Pvt. Ltd, at Coimbatore.
d) Is a trustee of NETHRA JYOTHI TRUST, a registered chraritable trust through which all the Eye camps and other charitable activities are directed.
Has been trained at premier eye centers around the world in Germany, Netherlands, Switzerland, Australia, Hongkong and Singapore.
Has been a guest speaker and invited faculty at various State, National and
International level meetings and seminars.
Has a number of scientific presentations to her credit.
Area of specialization in Ophthalmology Phacoemulsification
One of the Pioneers in India in LASIK REFRACTIVE CORRECTION having performed more than 18,000 procedures.
Heads the Glaucoma clinic at "The Eye Foundatio

Travelling the path....

In the past lamellar keratoplasty and automated lamellar keratoplasty were used to treat myopic refractive error. They involved the removal of a lenticule from the corneal stroma to flatten the central cornea and thus correct myopia using a mechanical microkeratome. Although introduced by Barraquer in the 1950s, it was only in the late 1980s and early 1990s wherein microkeratomes reached a level of refinement. However, because of higher complications with mechanical microkeratomes, LK techniques remained niche techniques to treat high myopia and never became part of the ophthalmic mainstream.

The excimer laser was introduced in 1983 and was used on human eyes to reshape the cornea from 1988 by a procedure known as photorefractive keratectomy. It involved mechanical scraping of the corneal epithelium followed by reshaping of the remaining corneal bed with the excimer laser. It obtained US Food and Drug Administration approval in 1995 and quickly became the procedure of choice to treat refractive errors.

However, because the corneal epithelium is removed, the patient experiences pain during the first postoperative day, the visual recovery is delayed, and there is a hyperopic overshoot for the first postoperative month. In some patients, especially higher myopes, it is seen that excimer laser PRK is followed by corneal haze and regression of the treatment. Today, despite significant improvements in laser ablation profiles, medication and wound-healing modulation regimens, and surgical technique, excimer laser PRK is performed on less than 20% of all refractive surgery patients.

In the early 1990s, the work of Burratto et al and Pallikaris et al married the concept of ALK with the excimer laser into a procedure known as laser-assisted in situ keratomileusis (LASIK). Laser-assisted in situ keratomileusis involved using a mechanical microkeratome to fashion a hinged flap of the cornea, with a thickness of 130 to 160 microns. Excimer laser reshaping was performed on the exposed corneal stroma, and the hinged flap was then refloated back on the cornea and allowed to heal in place without any sutures. Although LASIK with the mechanical microkeratome is very popular with surgeons, the mechanical microkeratome is associated with most of the complications of LASIK, like buttonhole flaps, incomplete flaps, irregular flaps, and flap displacements. In addition, mechanical microkeratomes sometimes make flaps that are inadvertently too thick, which leads in some cases to keratectasia, a progressive thinning and subsequent irregular steepening of the cornea. Mechanical microkeratomes have improved during the years.
However, many surgeons have now adopted the femtosecond laser as their primary means to make LASIK flaps. The introduction of a femtosecond laser to make LASIK flaps has the advantages of making more predictable and safer flaps and relatively aberration neutral flaps. However, it also has some disadvantages. There is a need for 2 lasers to complete the procedure, namely, the femtosecond laser to make the flap and the excimer laser to perform the laser ablation of the refractive lenticule. This leads to significant extra capital and maintenance costs and the consumable and license fees for 2 lasers. There is also significant workflow disturbance

within the laser suite, with the surgeon and the patient moving from one laser to another.

The femtosecond laser can be used to carve out a lenticule within the corneal stroma. The lenticule can then be extracted from within the corneal stroma, either by creating and lifting a hinged flap similar to LASIK or by extricating it using a small incision in the cornea. These techniques of femtosecond lenticule extraction are known as femtosecond lenticule extraction (FLEx) and small-incision lenticule extraction (SMILE), respectively. Both techniques represent all-in-one femtosecond laser refractive surgery because they represent novel integrated surgical techniques to perform corneal laser surgery in a single step and need only 1 laser to perform laser refractive surgery and have various clinical, practical, and economic advantages over the more traditional 2-laser solution.

Selection criteria

Currently ReLEx SMILE is available to treat myopic errors of upto – 10D spherical equivalent (up to -13D in newer upgrades) , with or without astigmatism of upto – 5D. It is at present not available for hyperopic correction. Patients are generally selected using the same criteria as LASIK.

The Technology

The VisuMax Femtosecond laser is used to perform ReLEx SMILE procedure. The VisuMax is capable of creating refractive lenticules within the cornea with high degree of accuracy. The VisuMax software allows the calculation of the refractive lenticule needed for the correction of a particular refractive error, and it also automates all stages of the procedure.

Figure 1: VisuMax Laser System

The Technique

Under aseptic conditions and topical anesthesia, patients are prepared in a manner usual for LASIK. A standard speculum is used to keep the eye open. In the VisuMax Laser System, the laser system remains fixed, whereas the patient position can be aligned by adjustment of the position of the patient bed with a joystick. The patient's eye is positioned under a curved contact glass interface during the operation of the femtosecond laser, and it is positioned under a surgical microscope integrated into the system during the phase of surgical manipulation. The eye view is relayed to the surgical microscope eye pieces in both cases to allow for full visual control during the entire procedure.

A sterile curved contact glass is attached onto the laser system optical aperture, and the patient is positioned some distance below it. The patient is then asked to look at a blinking fixation light, and the patient's eye is adjusted in relation to the contact glass interface. The surgeon monitors whether the centration is appropriate. After the surgeon is convinced that the centration is correct, suction is initiated to hold the cornea against the contact glass interface

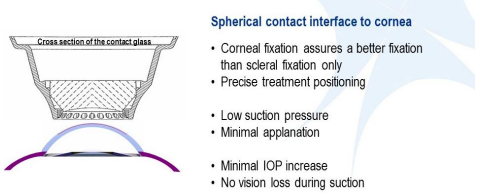


Figure 2: The innovative corneal interface concept

Once the contact interface is fixed, delivery of the femtosecond laser pulses is initiated. Femtosecond laser pulses with typical pulse energy of less than 200 nJ are delivered with a pulse repetition rate of 500 kHz. Each femtosecond laser spot creates a photodisruption within the cornea that initiates a chain of events that eventually results in a small volume of corneal tissue being converted into a gas bubble. If several millions of such pulses are laid down, a tissue disruption plane is created within the stroma as each gas bubble disrupts the corneal tissue at its respective position. It is possible with the VisuMax laser to create a 3-dimensional free-form incision plane anywhere within the cornea, with a precise shape.

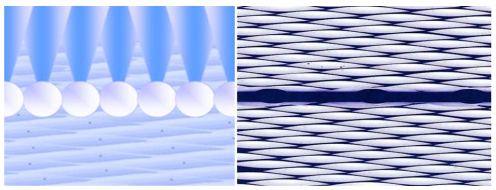
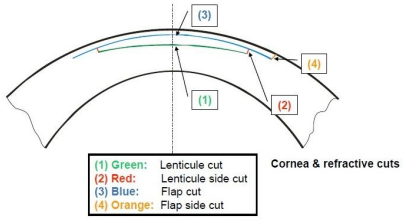


Figure 2: Photodisruption by femto laser

In these cases, 4 different tissue disruption planes are created for the procedure, These include (a) the posterior surface of the refractive lenticule, with a pre- programmed diameter based on the optical zone selected (b) the 360-degree cordal length vertical edge of the refractive lenticule, with a depth equivalent to the thickness of the edge of the lenticule; (c) the anterior surface of the refractive lenticule, which is extended by about 0.5 mm beyond the optical zone desired ; and finally (d) 30 to 50 degrees in cordal lengthfrom the surface of the cornea, with a depth up to the edge of the anterior part of the lenticule. The entire procedure takes less than 30 seconds, practically independent of the refractive error to be corrected. The spherocylindrical shape of the lenticule generated thus is designed to correct for refractive errors. The anterior surface of the lenticule can be programmed to be 100 microns or more below the corneal surface, similar to the flap thickness in LASIK. The lenticule diameter can be 5.00 to 7.00 mm while treating myopia and myopic astigmatism. The minimum thickness of the lenticule edge is 10 to 15 microns to support easier manual manipulation of the lenticule edge. In SMILE, the side cut incision can be 30 to 50 degrees.



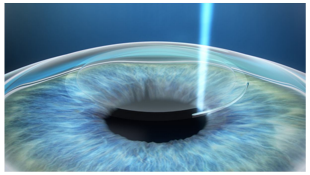


Figure 3: Tissue disruption planes

Once the femtosecond laser cutting procedure (treatment mode) is finished, the suction is automatically switched off, and the patient's eye is released from the contact glass and moved under the microscope (observation mode).The side cut incision is generally created superiorly or superotemporally to preserve the nasal and temporal nerve arcades and to provide surgical convenience. A small sharp- tipped instrument is used to open a small portion of the side cut incision. A small blunt spatula is inserted into the side cut incision, and the anterior surface of the lenticule is separated from the overlying cornea. A small sharp instrument is then used to enter the tissue disruption plane on the posterior side of the lenticule to separate the edge of the lenticule. A blunt spatula is then inserted through this edge below the lenticule and used to separate the posterior part of the lenticule from the underlying stroma. Once the lenticule is free from both surfaces, a small microforceps is inserted to grasp the lenticule and extract it from the corneal stroma. A 24-gauge cannula is inserted into the incision, and the corneal pocket is flushed with balanced salt solution. A PVA spear is used to wick off excess fluid from the side cut incision. After 30 seconds, the speculum is removed. Both eyes can be treated at the same time.

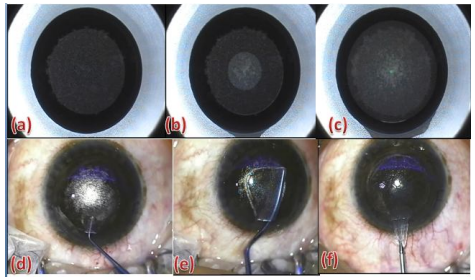


Figure 4: Surgical steps

(a) Posterior tissue disruption plane (lenticule cut)
(b) Anterior tissue disruption plane (Flap cut)
(c) Superior flap side cut incision

Femto Laser assisted

(d) Anterior plane dissection
(e) Posterior plane dissection
(f) Lenticule removed.

Manual

Post operative treatment:

Steroids and antibiotics for 1-2 weeks and artificial tears supplements for a period of 4 to 8 weeks after the procedure.

Complications:

1. Suction loss wherein the contact glass and cornea become detached during the procedure. May occur due to the patient squeezing the eye or moving suddenly. fluid ingress between the suction ports of the contact glass and the cornea, gas bubble migration and subsequent compressive forces against the contact glass.

In the event of suction loss, the VisuMax automatically goes into a restart mode based on the stage of the procedure at which the suction loss occurred. The general challenge in thissituation is redocking of the contact glass interface to the eye while retaining centration. Sometimes, the pupil is obscured by the gas bubbles, making this difficult. Depending on the stage at which the suction loss occurs, the restart mode repeats both femtosecond passes, only the flap pass, or only the side cut incision. In our experience, repeating the treatment immediately is convenient and does not seem to affect the results of the procedure.

2. The second intraoperative complication that is generally observed is while trying to separate the anterior lenticule surface from the overlying cornea ; the wrong plane is selected by the surgeon, and the posterior part of the lenticule is separated instead. In this case, the lenticule is stuck on the undersurface of the flap rather than on the stromal bed. The surgeon may then find dissection of the anterior plane more difficult. The lenticule may then be peeled off after delineating the edge. In case this is not possible, the VisuMax allows the creation of a side cut incision only, and it is best to convert the case into FLEx by repeating a 280- to 330-degree side cut incision.

3. In many cases, a fine scarring is observed at the flap edge or the lenticule edge. However, this is outside the pupillary zone and is visually nonsignificant. Some patients, especially chronic contact lens users before the procedure, experience dry eyes after the procedure. This is less frequent than the occurrence of dry eye symptoms after conventional LASIK.

4. Similar to any other refractive surgery procedure, there is likely to be a need for enhancements after the procedure. Currently, enhancements after FLEx and SMILE must be completed either by using an excimer laser PRK or by lifting the flap, and performing excimer laser corneal reshaping.

There are no other serious intraoperative or postoperative complications. Vertical gas breakthrough, transient light sensitivity syndrome, or rainbow glare are almost never seen.

Advantages over Femto-LASIK:

1. There are economic, clinical and workflow advantages of performing only femto procedures like ReLEx SMILE over Femto-LASIK in terms of saving on capital costs, maintenance costs and consumable costs.
2. In ReLEx, the lenticule is carved out within the cornea by cutting action, as opposed to ablation with excimer laser which depends on a number of other factors like corneal hydration levels, atmospheric humidity and temperature and also on the depth in the stroma at which ablation occurs. The scatter in the ablation rates is particularly high, when ablation depth is large as in cases of higher refractive error. Because of the femtosecond lasers cutting action, the scatter in the thickness of the lenticule is minimized and it is independent of the refractive error being treated.
3. The refractive predictability with the ReLEx procedure is higher than with an excimer laser, particularly for higher amounts of refractive errors.
4. With femtosecond laser, the peripheral loss of fluence is not a factor at all, and no compensation needs to be carried out. So the amount of tissue required per diopter of treatment is smaller than that required with an excimer laser which compensates for the peripheral energy loss.
5. The total amount of energy laid down into the cornea is also much less than with an excimer. Since there are some evidences that the fast heat generated by excimer laser has some adverse effect on corneal healing, the low energy used in ReLEx SMILE is a welcome benefit.
6. The small incision heals relatively quickly, causes less patient discomfort, and little risk of flap displacement.
7. The small flap diameter and the small side-cut incision means that there is smaller likelihood of cutting corneal nerves, perhaps leading to less problems of dry eyes.
8. Finally, the procedure saves working time as there is no time loss in switching patients from one laser to another.

Re treatment following SMILE:

The Circle Scan software, now available helps convert the cap into a flap with a larger diameter than the original cap. This flap may be lifted like in the femto-LASIK procedure and excimer laser may then be used for refractive error correction. Otherwise a PRK procedure may be performed.

Tissue Addition Applications

The intact lenticule extracted following SMILE is finding innovative uses. Intrastromal insertion of the lenticule in femtosecond laser created laser pockets can be used to create hyperopia. Sachdev technique for crosslinking the ultrathin ectatic cornea describes the use of this lenticule to augment the intraoperative stromal thickness while performing UV irradiation for corneal crosslinking. Placement of this lenticule over the apex of the cone allows effective crosslinking in patients with stromal thickness less than 400 microns.

References:

1. All-in-One Femtosecond Laser Refractive Surgery
Rupal Shah, MS, Samir Shah, MTech, MS, and Hartmut Vogelsang *Tech Ophthalmology 2011;9: 114Y121)*
2.Barraquer Jl. The history and evolution of keratomileusis. *Int Ophthalmol Clin. 1996;36(4):1Y7.*
3. Ibrahim O, Waring GO III, Salah T, et al. Automated in situ keratomileusis for myopia. J Refract Surg. 1995;11: 431Y441.
4. Trokel SL, Srinivasan R, Braren B. Excimer laser surgery of the cornea. Am J Ophthalmol. 1983;96:710Y715.
5. McDonald MB, Kaufman HE, Frantz JM, et al. Excimer laser ablation in a human eye: case report. Arch Ophthalmol. 1989;107(5):641Y642.
6. Lipshitz I, Loewenstein A, Varssano D, et al. Late-onset corneal haze after photorefractive keratectomy for moderate and high myopia. Ophthalmology. 1997;104(3):369Y373.
7. Sandoval HP, de Castro LE, Vroman DT, et al. Refractive surgery survey 2004. J Cataract Refract Surg. 2005;31:221Y233.
8. Buratto L, Ferrari M, Rama P. Excimer laser intrastromal keratomileusis. Am J Ophthalmol. 1992;113:291Y295.
9. Pallikaris IG, Papatzanaki ME, Siganos DS, et al. A corneal flap technique for laser in situ keratomileusis: human studies. Arch Ophthalmol. 1991;109:1699Y1702.
10. Binder PS. Ectasia after laser in situ keratomileusis. J Cataract Refract Surg. 2003;29:2419Y2429.
11. Binder PS. Analysis of ectasia after laser in situ keratomileusis: risk factors. J Cataract Refract Surg. 2007;33:1530Y1538.
12. Ratkay-Traub I, Ferincz IE, Juhasz T, et al. First clinical results with the femtosecond neodynium-glass laser in refractive surgery. J Refract Surg. 2003;19:94Y103.
13. von Jagow B, Kohnen T. Corneal architecture of femtosecond laser and microkeratome flaps imaged by anterior segment optical coherence tomography. J Cataract Refract Surg. 2009;35:35Y41.
14. Steinert RF, Ignacio TS, Sarayba MA. BTop hat[Yshaped penetrating keratoplasty using the femtosecond laser. Am J Ophthalmol. 2007;143:689Y691.
15. Ertan A, Kamburo?lu G. Analysis of centration of Intacs segments implanted with a femtosecond laser. J Cataract Refract Surg. 2007;33:484Y487.
16. Ruiz L, Cepeda L, Fuentes V. Intrastromal correction of presbyopia using a femtosecond laser system. J Refract Surg. 2009;25(10):847Y854.
17. Tran DB, Sarayba MA, Bor Z, et al. Randomized prospective clinical study comparing induced aberrations with IntraLase and Hansatome flap creation in fellow eyes: potential impact on wavefront guided laser in situ keratomileusis. J Cataract Refract Surg.
18. Sekundo W, Kunert K, Russmann C, et al. First efficacy and safety study of femtosecond lenticule extraction for the correction of myopia Six Month Results. JCataractRefractSurg. 2008;34:1513Y1520.
19. Seider M, Ide T, Kymionis G, et al. Epithelial breakthrough during IntraLase flap creation for laser in situ keratomileusis. J Cataract Refract Surg. 2008;34:859Y863.
20. Stonecipher KG, Dishler J, Ignacio TS, et al. Transient light sensitivity after femtosecond laser flap creation: clinical findings and management. J Cataract Refract Surg. 2006;32:91Y94.
21. Bamba S, Karolinne R, Ramos-Esteban J, et al. Incidence of rainbow glare after laser in situ keratomileusis flap creation with a 60 kHz femtosecond laser. J Cataract Refract Surg. 2009;35:1082Y1086.
22. Blum M, Kunert K, Gille A, et al. LASIK for myopia using the Zeiss VisuMax femtosecond laser and MEL 80 excimer laser. J Refract Surg. 2009;25(4):350Y356.
23. Mrochen M, Seiler T. Influence of corneal curvature on calculation of ablation patterns used in photorefractive laser surgery. JRefractSurg. 2001;17:S584YS587.
24. Dougherty PJ, Wellish KL, Maloney RK. Excimer laser ablation rate and corneal hydration. Am J Ophthalmol. 1994;118(2):169Y176.
25. Walter KA, Stevenson AW. Effect of environmental factors on myopic LASIK enhancement rates. J Cataract Refract Surg. 2004;30(4):798Y80