NIIOS Journal
Netherlands Institute for Innovative Ocular Surgery

The SurgiCube® at the Hippocratech booth at the 2007 ESCRS meeting in Stockholm.

The SurgiCube®: Revolutionary surgical treatment facility

The **SurgiCube®** was designed by the Netherlands Institute for Innovative Ocular Surgery. Since its introduction in 2004, thousands of patients have been operated on in the **SurgiCube®** and both the ophthalmic surgeons as well as their patients showed great satisfaction with the system. A questionnaire even showed that over 90 percent of the people prefer to have surgery in the relaxing atmosphere of the **SurgiCube®** rather than in the regular operating theatre.

The **SurgiCube®** is a patient friendly, easy access stand-alone treatment facility that provides the cleanest fully conditioned air possible for performing sterile intraocular surgery. Like with every surgical procedure it is of utmost importance to minimize the risk for complications. A procedure in the **SurgiCube®** guarantees treatment in ultra clean environment that is superior to regular operating theatres, exactly where it is needed most: in the operating area. All important possible contamination sources, such as the patients themselves and the surgical microscope are positioned outside the air flow, that is continuously monitored.

The outcome of ophthalmic surgical procedures is improving fast with high-tech solutions and technical improvements. Surgery has become relatively safe, well predictable and very effective. Patients turn into clients, and hospitals see the need for friendly day care units, while private clinics are getting more and more appreciated. For surgeries however, the patient still has to enter an intimidating operating theatre complex. In addition, shortage of operating staff, time and money may cause huge logistical problems, and in many hospitals the waiting list extends over months. As a result, the client becomes a patient again.

Working with the **SurgiCube®** has proved to be revolutionary. Several public, private and university clinics are convinced: microsurgery will never be the same. Ophthalmic procedures such as cataract, refractive, glaucoma, oculoplastic, corneal and orbital surgery are now being performed in the **SurgiCube®**. Our special unit, the **SurgiCube® iVi**, has been specifically designed for the treatment of neovascular AMD. Specially sized and easy to install so you can start performing your intravitreal injections in a fully controlled sterile environment. Patient friendly, stand-alone, safe and without the hassle of the regular operating theatres.

For information regarding the **SurgiCube®** please contact Mr. Ramón Hilberink at +31 10 297 44 66 or visit the website: www.surgicube.com.

Netherlands Institute for
Innovative Ocular Surgery

Laan Op Zuid 390
3071 AA Rotterdam
The Netherlands
Tel. +31 10 297 4444
Fax +31 10 297 4440
E-mail: info@niios.com
www.niios.com

NIIOS Journal
Netherlands Institute for Innovative Ocular Surgery

Edition: 9 English, November 2007
www.niios.com

Referrals to Melles CorneaClinic Rotterdam

For referrals to Melles CorneaClinic Rotterdam, please use the referral form enclosed with this NIIOS Journal. The referral form can also be downloaded from the NIIOS website at www.niios.com: see right-hand column on the index page. Please fax the referral form to +31 10 297 4440, and one of our international secretaries will make further arrangements.

If you want to contact us by phone or e-mail, please call Ms Kim Herders at extension +31 10 297 4444 or mail to herders@niios.com.

NIIOS moves to new building in January 2008

Since December 2004, our suite at Laan Op Zuid 390, Rotterdam, has served us well to start up Amnitrans Eyebank and Melles CorneaClinic Rotterdam. Last year, however, it became apparent that expansion of our facilities would be required to support the expanding activities of the Netherlands Institute for Innovative Ocular Surgery in the nearby future. Fortunately, we found a larger suite a few blocks down the Laan Op Zuid (no 88).

Our new suite, located also in the center of Rotterdam, has excellent connections for public transportation and is located close to two freeway exits. At the same time, the patient waiting room has a nice view on 'The Erasmus bridge' and 'The Maas', the river that runs from the eastern part of our country through Rotterdam to the North Sea.

The new NIIOS suite is part of a building designed by the famous German architect Hans Kollhoff, who also designed the Mainplaza in Cologne and the Daimler-Chrysler building in Berlin.

Artist impression of the new location of the Netherlands Institute for Innovative Ocular Surgery

Descemet membrane endothelial keratoplasty (DMEK):

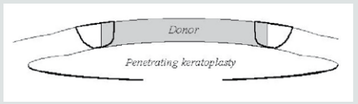
20/20 within 1 week

In the past year, the Netherlands Institute for Innovative Ocular Surgery (NIIOS) presented the 1-2 year results of the selective transplantation of Descemet membrane for the management of corneal endothelial disorders, tentatively named Descemet membrane endothelial keratoplasty (DMEK).

Started as a NIIOS-project called 'posterior lamellar keratoplasty', DMEK reflects the most recent improvement of earlier techniques for endothelial keratoplasty designed by the NIIOS, such as DLEK and DSEK. DMEK may even turn out to be the final step, since a more refined anatomical restoration can hardly be obtained: only the diseased corneal layers (Descemet membrane and the endothelium) are replaced by donor tissue.

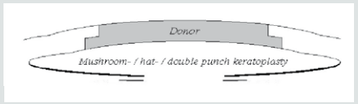
In a first series, 25 patients with Fuchs endothelial dystrophy or pseudophakic bullous keratopathy underwent DMEK under local anesthesia. All surgeries were performed in a stand-alone 'surgical intervention unit' (SurgiCube®, see backside of this NIIOS Journal) in Melles CorneaClinic Rotterdam in collaboration with Amnitrans Eyebank. Pre- and postoperative medication was similar to that in penetrating keratoplasty.

Continued on page 2

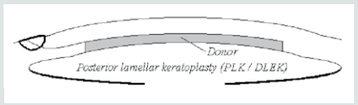


Conventional technique for corneal transplantation (penetrating keratoplasty, **PK**)

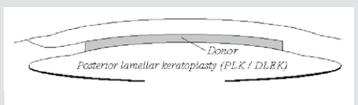
Corneal transplantation techniques described by the NIIOS since 1996



Double punch technique, later popularized in US as '**Mushroom**' or 'Top hat keratoplasty'; also described in 1950/1960s

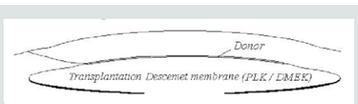


Posterior lamellar keratoplasty through 9.0 mm scleral incision, later popularized in US as 'Deep Lamellar Endothelial Keratoplasty (**DLEK**)'



Posterior lamellar keratoplasty through 5.0 mm scleral incision, later popularized in US as 'Small incision Deep Lamellar Endothelial Keratoplasty (**Small incision DLEK**)'

Posterior lamellar keratoplasty through 5.0 mm scleral incision using descemetorhexis, later popularized in US as 'Descemet Stripping Endothelial Keratoplasty (**DSEK**)'



Posterior lamellar keratoplasty by descemetorhexis and selective transplantation of Descemet membrane through 3.0 mm corneal incision, tentatively named 'Descemet Membrane Endothelial Keratoplasty (**DMEK**)'

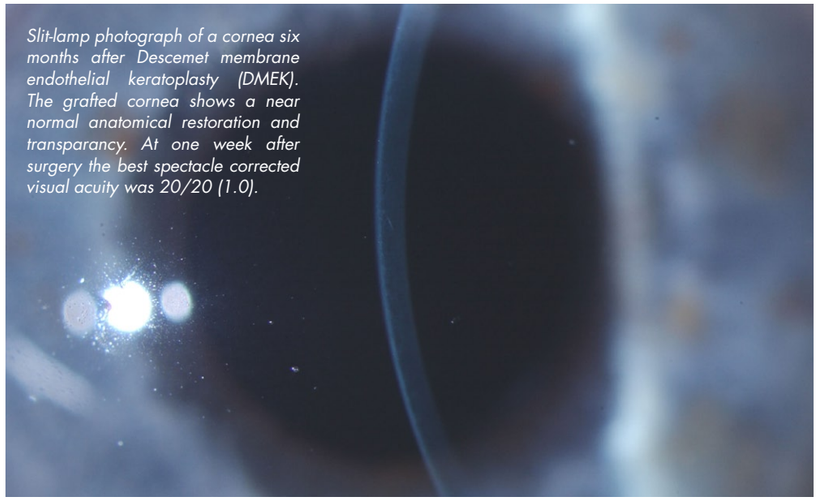
Continued from page 1

From the first patient onward, the clinical outcome proved spectacular. In patients with an uncomplicated Fuchs endothelial dystrophy, DMEK was found to potentially provide a visual rehabilitation to a best spectacle corrected visual acuity of 1.0 (20/20) within the first week. To the best of our knowledge, such a visual performance of a grafted cornea is unprecedented in the field of keratoplasty surgery. The main challenge today may be that in about one third of DMEK cases the graft does not immediately attach in the early postoperative phase. As a result, the surgical result is either exceptionally good or an early failure is seen. Although the latter cases may be managed by a re-bubbling procedure, the mainstream of research at the NIIOS currently focuses on improving graft attachment.

With the development of DMEK, a lot of attention was given to minimizing the risk of endothelial cell damage during surgical preparation and transplantation of surgical preparation of the graft, to obtain the best possible condition for long-term graft survival. Although follow-up times are relatively short, DMEK may provide an average endothelial cell density of >2000 cells/mm^2 at six months, and >1800 cells/mm^2 at one year. Unexpectedly, the cell counts as well as the overall condition of the endothelium appear to be better in DMEK than in DSEK or DSAEK at similar time intervals.

From a logistical point of view, DMEK may have the advantage that a Descemet transplant can be prepared by stripping the donor Descemet membrane from a corneo-scleral rim, as routinely supplied by eyebanks throughout the world. In contrast to DSAEK or FS-DSEK no expensive equipment is required, such as a microkeratome or a femtosecond laser. Hence, DMEK may be far better accessible to corneal surgeons in various countries and in different settings.

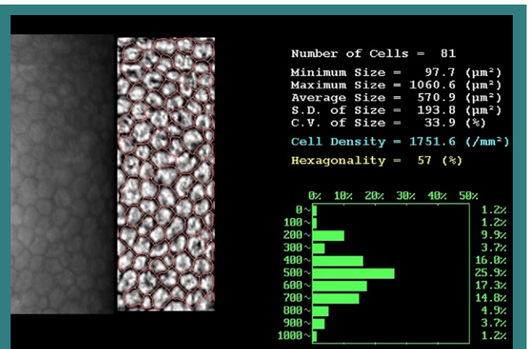
Given the fact that DMEK may give a visual rehabilitation that almost mimics that after phaco-emulsification, and if the percentage of attachments can be improved without re-bubbling, DMEK may soon become the preferred treatment method for corneal endothelial disorders. Like in DLEK and DSEK, detailed instruction may be even more important in DMEK. The procedure may be most rewarding with a thorough understanding of the surgical technique as well as the eyebank logistics, that both require more delicacy. For this reason, the NIIOS educational wetlab instruction courses are currently extensively revised and will start again in 2008.



Slit-lamp photograph of a cornea six months after Descemet membrane endothelial keratoplasty (DMEK). The grafted cornea shows a near normal anatomical restoration and transparancy. At one week after surgery the best spectacle corrected visual acuity was 20/20 (1.0).

References:

1. Melles G.R.J., Ong T.S., Ververs B., Van der Wees J.: Descemet membrane endothelial keratoplasty (DMEK). Cornea 2006;25:987-990.
2. Melles G.R.J. Posterior lamellar keratoplasty: DLEK to DSEK to DMEK (editorial). Cornea 2006;25:879-81.
3. Melles G.R.J., Ververs B., Ong T.S., Van der Wees J. Preliminary results of Descemet membrane endothelial keratoplasty (DMEK). Am J Ophthalmol, in press.



Endothelial cell density six months after DMEK. The endothelial mosaic shows a normal pattern with an acceptable cell density.

Are Little Brothers watching you?

You probably feel unnoticed by the indoor plants in your living room. Without restraint, you may do the most embarrassing things in their presence. If you plan to continue doing so, please stop reading now.

In humans, the combination of a refractive system (built from a cornea and a crystalline lens) and a receptive system (built from light-sensitive pigment in the foveal cones and activated neurons) provides a sensation experienced in our brains as a 'visual perception'. With some variation, most animal species have a similar optical system that we commonly refer to as 'an eye'.

However, creatures other than man and animals may also have eyes. Refractive lenses in combination with biochemical activation of underlying pigments were also found in plants, for example the indoor plant you are staring at right now. Recently, one of the biologists involved in describing the plant eye visited the Melles CorneaClinic Rotterdam, giving the editorial staff of the NIIOS Journal the opportunity to really get to the bottom of what may sweep away the little privacy we had left.

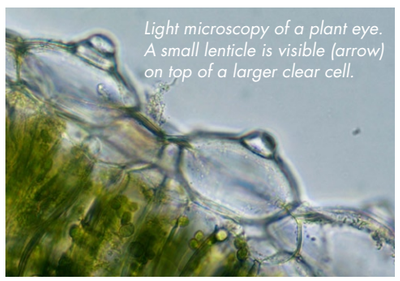
Fittonia verschaffeltii.

Q: It does not sound as if it is true. Everybody knows that plants do not have eyes?

A: Plants do not have really have eyes like those in animals or humans. However, eye-like cells are present in the leaves of some plants, for example in the Fittonia verschaffeltii.

Q: If plants do have eye-like structures, what is their level of development?

A: These 'optical organs' consist of a small biconvex lenticular cell on top of a big cell protruding from the epidermis surface. Both cells are naturally clear and have a refractive index, so they function as a highly efficient optical device. Even under humid conditions, when the leaf is wet, the optical system is functional, because the lenticular cell stands out through the thin layer of water covering the leaf.



Light microscopy of a plant eye. A small lenticle is visible (arrow) on top of a larger clear cell.

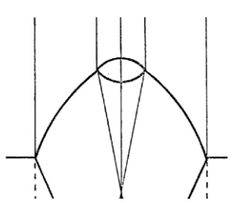
Q: What is the function of such a photoreceptive organ?

A: Plants on the ground of a tropical forest live in dim light because of the surrounding trees and bushes. To survive, the plant does not want to waste any sunlight. The purpose of the plant eye clearly is to focus the incoming light onto the underlying photoreceptive pigment, to increase the photosynthetic performance. It has also been suggested that the optical system plays a role in phototropism (orientation towards light). When a leaf is facing the sun it catches a maximum amount of light. So the petiole, the stalk that links the leaf to the stem, bends to favor this position. If the light does not hit the leaf surface at a perpendicular angle, the refractive light is outcentered at the bottom of the plant eye, and this would evoke a signal travelling to the petiole to reposition the leaf. At the University of Geneva we tested this hypothesis, but we found that the petiole itself was the site of light perception and re-direction. So it is unknown if the 'optical organs' play a true role in the adaptation of the plant to its environment.

Q: Is there any evolutionary relation between the human eye and the optical system in plants?

A: Plants are sessile organisms so they had to develop different evolutionary strategies for survival than animals. Plants are tightly bound to their environment from which they retrieve information for growth adaptation and developmental responses. These responses are known as tropisms. Although the molecular basis of phototropism is still investigated, two phototropins have been recognized. Both are derived from a non-covalent-binding of two flavin mononucleotides, clearly different from the rhodopsin or any kind of opsins (carotenoid derivative) found in animals.

However, opsin-related proteins do exist in the photosynthetic alga Chlamydomona reinhardtii, an organism belonging to same evolutionary branch as green plants. These single-celled algae have a yellow-orange eyespot with carotenoids that acts as a functional eye with photoreceptor proteins and biochemical downstream elements. This eye also instructs the two flagella of the alga to beat and orient the cell into an optimal position for light exposure to its chloroplast. This behavior is called phototaxis. Invertebrate and vertebrate vision could have developed from the same light sensory system as the one found in unicellular flagellates. However the microbial-type rhodopsin differs from the animal-type rhodopsin, so the evolutionary pathway may also have been completely independent… But that's another story.



Principle of the refractive mechanism in a plant eye. Like in a human eye, incoming light rays are focused onto photoreceptive pigment in the posterior part of the system.

References

- Simon P and Montavon M, 1977. Etude physiologique de la photoperception et de l'effet lentilles des 'organes optiques' chez Fittonia verschaffeltii. Travail de diplôme, Université de Genève.
- Vogelmann TC, Bornmann JF and Yates DJ. Focusing of light by leaf epidermal cells. Physiol Plant 1996;98:43-56.

NIIOS Advanced lamellar keratoplasty wetlab courses in 2008

Deep anterior lamellar keratoplasty (DALK)
- Manual dissection using optical reference plane

Posterior lamellar keratoplasty
- Descemet stripping endothelial keratoplasty (DSEK)
- Descemet membrane endothelial keratoplasty (DMEK)

- February 12th/13th: DALK / DSEK course
- March 18th/19th: DSEK / DMEK course
- April 8th/9th: DALK / DSEK course
- May 13th/14th: DSEK / DMEK course
- August 26th/27th: DALK / DSEK course
- September 16th/17th: DSEK / DMEK course
- October 21th/22th: DALK / DSEK course
- November 25th/26th: DSEK / DMEK course

Each course is scheduled on Tuesday/Wednesday. On Tuesday, the course participants join live surgery sessions; on Wednesday, various techniques are practiced during educational wetlab sessions.

Level: Advanced - Corneal surgeons and senior eyebank technicians. See www.niios.com for applications and updates.