

MAY 2015 VOL. 11, NO. 4

ISSUE FEATURE

Combination therapy for exudative AMD

Effective management using anti-VEGF and photodynamic therapy

CATARACT & REFRACTIVE

Achieving balanced vision

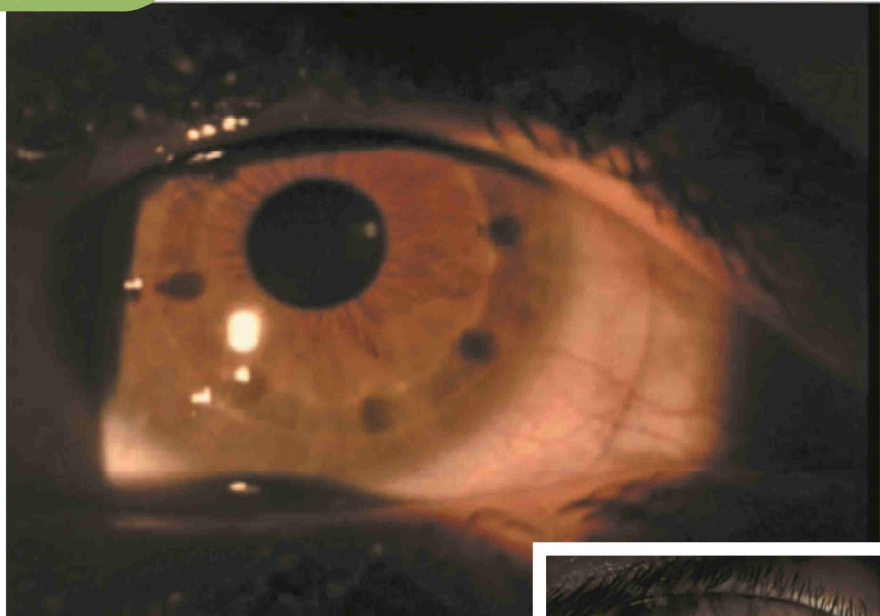
Clinical experiences of a corneal inlay for presbyopia correction

GLAUCOMA

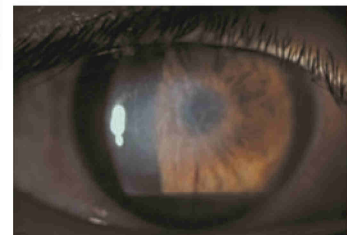
IOP lowering in PEG and POAG

Filtration device equally effective at reducing intraocular pressure in both PEG and POAG

CORNEA



Occasionally, post-cataract surgery, dysfunctional endothelial cells can cause corneal oedema. A new treatment modality has been designed to reduce and, in most cases, stop the oedema in 24–48 hours. (ABOVE) Hyperosmotic contact lens on cornea. (RIGHT) Corneal oedema post-cataract surgery.



CORNEAL OEDEMA

A new lens-based treatment approach to corneal oedema following cataract surgery

PAGE 38

New treatment reduces corneal oedema after cataract surgery

A new treatment modality with the Hyper CL soft contact lens

**By Professor Claes
Feinbaum, MSc, PhD**

The back layer of the cornea is made up of endothelial cells that keep the cornea clear. All cataract surgery (even 'perfect' surgery) does some damage to these endothelial cells. Most corneas have plenty of 'extra' endothelial cells, so a small degree of endothelial cell loss from cataract surgery doesn't usually cause any problem. However, occasionally, after cataract surgery, the endothelial cells don't function well enough to keep the cornea clear, causing poor vision and often discomfort. The cells may recover over the first few months after surgery.

If the cornea doesn't clear, treatment options include drops to decrease swelling (saline-like drops) and corneal transplantation, either a partial thickness transplant [e.g., Descemet's stripping endothelial keratoplasty (DSEK)] or a full thickness corneal transplant.

A common complication of cataract surgery

Corneal oedema from inadequate endothelial pump function is one of the most common complications of cataract surgery. Various causes for this endothelial dysfunction can be divided into four categories including:

- (a) mechanical injury,
- (b) inflammation/infection,
- (c) chemical injury, and
- (d) concurrent eye disease.

Postoperative corneal oedema can be localized or diffuse. Postoperative localized stromal and/or epithelial oedema, especially in the half of the cornea near the main section indicates intraoperative trauma. Factors that predispose to corneal oedema following cataract surgery include the following: intraoperative mechanical endothelial trauma, prior endothelial disease or cell loss, excessive postoperative inflammation, and prolonged postoperative elevation of intraocular pressure (IOP).¹

Raised IOP manifests as diffuse microcystic epithelial oedema, which is best visualized

by retro-illumination. Postoperative corneal stromal oedema could also indicate pre-existing endothelial pathology as in Fuchs' endothelial dystrophy. Preoperatively patients should be carefully examined for evidence of Fuchs' dystrophy or other conditions that produce a low endothelial cell count.¹⁻³

Previous studies

Previous studies have found that at birth the corneal endothelial cell density is approximately 5000 cells/mm² and until the age of 20 years there is a significant decline in this number. Subsequently this decrease plateaus to a rate of 0.6% per year.

In normal circumstances the reserves of endothelial cells mean that there are enough to last a lifetime.⁴ The role of the corneal endothelium is to maintain the correct level of corneal hydration. It forms a physical barrier between the corneal stroma and aqueous humour and acts as an ion pump.

Injury of a significant number of cells results in significant decrease in endothelial cell density and this can impair the ability of the

IN SHORT

► **The back layer of the cornea is made up of endothelial cells that keep the cornea clear. All cataract surgery does some damage to these cells, although due to the number of extra cells available in most corneas this damage doesn't cause any problems. However, occasionally, post-cataract surgery endothelial cells don't function well enough to keep the cornea clear, which can commonly cause corneal oedema. Here, Prof. Feinbaum describes a new treatment modality that has been designed to reduce and in most cases stop the oedema in 24-48 hours.**

endothelium to maintain corneal clarity, resulting in irreversible corneal oedema. The patient will experience permanent blurring in their vision and ocular pain. There are a number of factors that could lead to endothelial damage during phacoemulsification.⁵

Phacoemulsification effects

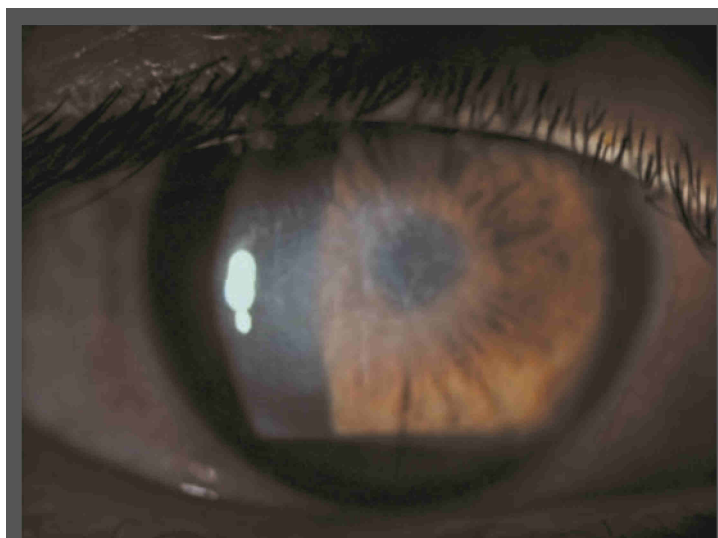
Localized temperature increases, associated with the phacoemulsification probe, can lead to thermal damage to adjacent corneal tissue. Some types of phaco probes are now available with cooling functions to counteract this effect.

High irrigation or aspiration rates can result in turbulent flow and air bubbles or lens particles connecting with and causing damage to the endothelium. It may be possible to adjust irrigation and aspiration flow rates to minimize this.

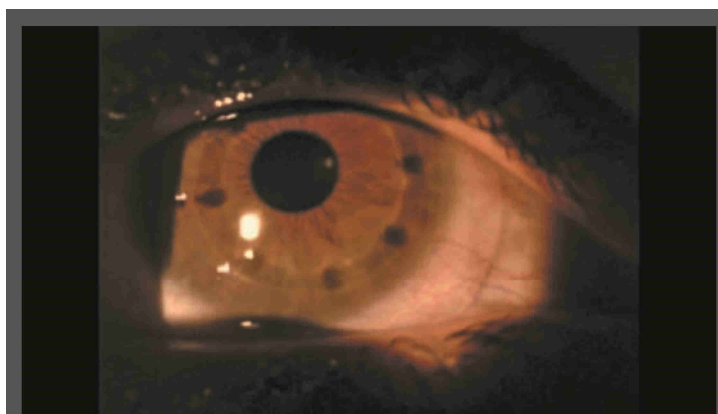
Excessive duration of phacoemulsification may also result in endothelial cell damage.

The ultrasound energy used in phacoemulsification is also associated with the production of free radicals.⁶ Free radicals are reactive species with one or more unpaired electrons in their outer orbits. Such chemicals can cause damage to the corneal endothelium known as oxidative stress.³

Pseudophakic bullous keratopathy describes the irreversible oedema and endothelial cell damage that occurs after cataract surgery. The advent of phacoemulsification techniques and the use of IOLs and ophthalmic viscosurgical devices have helped to reduce the number of cases of pseudophakic bullous keratopathy following cataract surgery. The most common cause of corneal endothelial decompensation is surgical trauma.⁷



(FIGURE 1) Corneal oedema post cataract surgery.



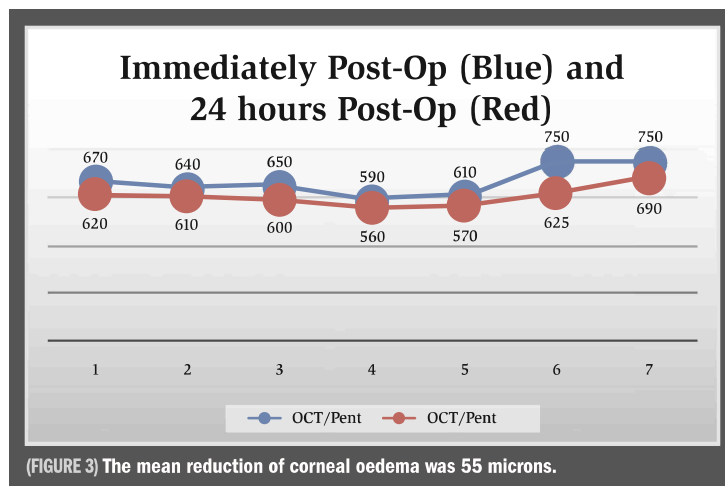
(FIGURE 2) Hyper CL on cornea.

Therapeutic considerations

Postoperatively corneal oedema and inflammation should be aggressively treated with topical corticosteroids, and intraocular pressure should be controlled below 20 mmHg. In patients with diffuse epithelial oedema, tonometry should be performed and if IOP is raised, the condition should be treated with topical and/or systemic antiglaucoma medication. Reduction of IOP is important for reducing the corneal oedema because increased IOP

can compromise endothelial cell function, lead to epithelial oedema, and cause further endothelial damage.^{3,7}

Therapy for pseudophakic corneal oedema and aphakic corneal oedema is aimed at reducing discomfort and/or increase visual acuity. The corneal oedema associated with phacoemulsification is chronic and usually non-inflammatory. Several medical treatment options are available. Epithelial oedema can often be managed



with topical hypertonic agents such as sodium chloride (5%) ointment or drops. Hypertonic eye ointment at night is particularly useful because the oedema tends to be more severe on waking in the morning because of lack of evaporation during the night when the eyes are closed.⁷

A new treatment modality

A new modality of treating corneal oedema has been developed by Eye-Yon Medical in Israel. It is a specially designed soft contact lens that will, over 24–48 hours, reduce and in most cases stop the oedema. The Hyper-CL is a hyperosmotic contact lens. The unique structure of the lens enables extraction of fluid from the corneal stroma, combined with increased evaporation over the lens surface. The dual base curve combined with the groove and the holes inside the lens creates a micro-environment above the cornea centre that holds fluid with high ionic concentration and thereby absorbs fluids from the cornea.

On a preliminary series of 7 eyes, the following results were obtained after 24 hours of wear of the Hyper-CL soft contact lens after cataract surgery. Patients

with pachymetry readings above 590 µm were selected for the treatment with the contact lens. The patient was fitted with the lens directly after surgery and pachymetry was performed. The patient returned 24 hours later and the lens was removed and pachymetry was performed again. The post-surgical pain was also diminished and visual acuity improved dramatically.

Further, there are indications that the Hyper CL soft contact lens can act as a reservoir for ophthalmic medical drops without the drops interfering with lens parameters. In addition, it must be added that there was no control group in this experiment. A control group is composed of participants who do not receive the experimental treatment. No special treatment for oedema was considered for corneal thicknesses below 590 µm.

A study conducted by Drs Hamid Nourouzi, Jaleh Rajavi and Mohamad Ali Okhovatpour (Department of Ophthalmology, Imam Hossein Medical Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran) showed that corneal thickness stabilized in 74% of patients within the first week and in 26%

of patients during the second week.⁸ Older patients and more primary corneal oedema needed longer time to recover ($P < 0.0001$).

In conclusion, it can be stated that the Hyper CL serves as a good complement for treating post-surgical corneal oedema, reducing the need for eye drops and promoting fast recovery. The lens might feel uncomfortable initially. The visual acuity recovery will also be faster. The Hyper CL is a safe method for treatment of corneal oedema.

REFERENCES

1. M.K. Reddy. *Indian J Ophthalmol.* 1995;**43**(4):201-209.
2. Wright et al., *Arch Ophthalmol.* 1988;**106**(6):740-744.
3. M. Yanoff, J.S. Duker. *Ophthalmology*, 2nd Ed. **St. Louis, Mosby, 2004.**
4. H.F. Edelhauser. *Cornea.* 2000;**19**:263-273.
5. J. Takahashi. *J Nippon Med Sch.* 2005;**72**(1):4-12.
6. A. Holst et al., *Curr Eye Res.* 1993;**12**(4):359-365.
7. Narayanan et al., *Cornea.* 2006;**25**(9):993-1004.
8. H. Nourouzi et al., *Am J Ophthalmol.* 2006;**142**(4):671-673.

PROFESSOR CLAES FEINBAUM, MSC, PHD

E: claes.g.feinbaum@gmail.com

Prof. Feinbaum is a guest professor at the Department of Ophthalmology, Barzilai Medical Center in association with the health sciences of Ben Gurion University of the Negev, Beer Sheva, Israel.

Prof. Feinbaum is a consultant to Vision4You, Lund, Sweden, and a research and clinical consultant to EyeYon.