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MAILBOX

Modified corneal collagen crosslinking reduces corneal oedema and diurnal visual fluctuations in Fuchs dystrophy

Crosslinking of corneal collagen with riboflavin and ultraviolet-A irradiation (CXL) induces crosslinks within and between collagen fibres. CXL increases corneal biomechanical and biochemical stability,¹ and is currently used clinically to treat keratactasia.^{2,3} CXL also significantly reduces the stromal swelling capacity.⁴ We investigated whether a modified CXL treatment protocol would be beneficial in early Fuchs dystrophy with various degrees of corneal oedema and diurnal variations in visual acuity.

MATERIALS AND METHODS

CXL was performed as published previously,² with the following modification: in cases where the stroma was thicker than 450 μm after abrasion and 30 min of instillation of isoosmolar riboflavin solution, glycerol 70% solution was applied every 5 s

for 2 min, and the central corneal thickness (CCT) was measured using ultrasound pachymetry (Tomey GmbH, Erlangen, Germany). Glycerol 70% solution was administered repeatedly until the target corneal thickness of 370–430 μm was reached. During irradiation (UV-X, Peschke Meditrade, Cham, Switzerland), CCT was monitored by ultrasound pachymetry every 5 min, and glycerol 70% solution was applied, if necessary.

RESULTS

Three eyes in two patients were treated using this modified CXL protocol. A 50-year-old woman with Fuchs dystrophy and a history of 3 years of diurnal visual fluctuations was referred to us in March 2008. The preoperative best spectacle-corrected visual acuity (BSCVA) was 20/50. We performed modified CXL in the left eye.

At 1 month after CXL, Scheimpflug analysis (Pentacam, Oculus Instruments, Wetzlar, Germany) of CCT showed a reduction of more than 100 μm , and the corneal thickness spatial profile (CTSP) and percentage of increase in thickness (PIT) showed a regularisation of the 'flattening' typical for Fuchs dystrophy (figure 1). Accordingly, diurnal analysis of corneal thickness showed

a distinct postoperative reduction in CCT at all time points measured (figure 2). One month after CXL, the patient reported a reduction in diurnal visual fluctuations, and we measured an increase in BSCVA to 20/32. The patient showed stable topographical and visual acuity at the 3-month follow-up.

DISCUSSION

Fuchs endothelial dystrophy is characterised by corneal swelling and oedema. In early stages of the disease, the endothelial proton pump is compromised, leading to diurnal CCT variations and fluctuations in visual acuity. Since CXL reduces the corneal swelling capacity,⁴ we investigated whether CXL would be beneficial in early Fuchs dystrophy.

We modified the standard CXL treatment protocol by reducing corneal thickness prior to irradiation. Because the standard parameters only treat the anterior 270–330 μm ,¹ we used glycerol 70% solution intraoperatively to dehydrate and thin the cornea prior to and during irradiation.

We saw a distinct reduction in CCT, an improvement in the corneal thickness spatial profile (CTSP) and an increase in BSCVA 1 month after treatment which remained stable at the 3-month follow-up.

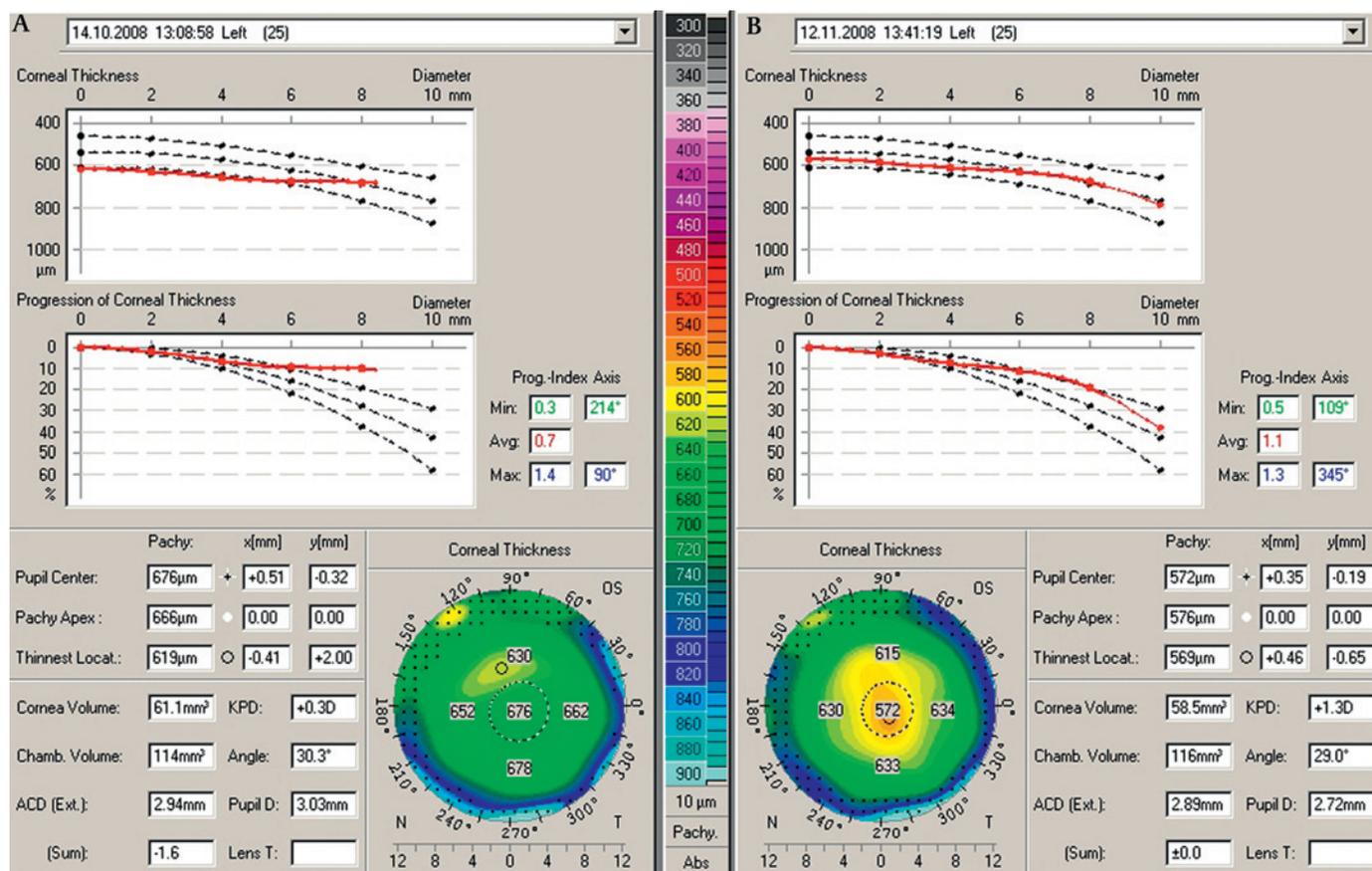
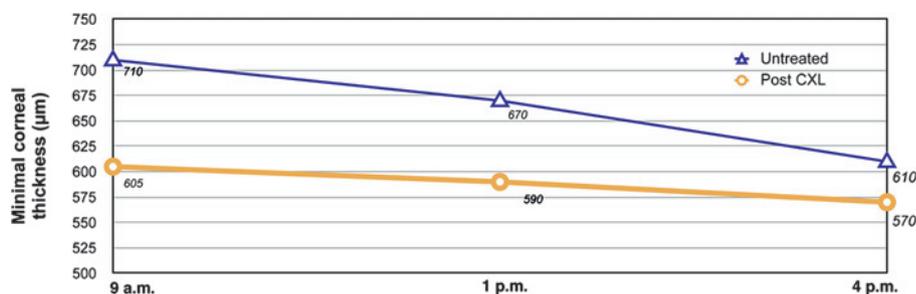


Figure 1 Scheimpflug analysis of corneal thickness before (A) and 1 month (B) after crosslinking (CXL). Central corneal thickness (CCT) is reduced by more than 100 μm at 1 month after CXL (arrows). Before CXL, analysis of the corneal thickness spatial profile and percentage increase in thickness shows a 'flattening' typical for Fuchs dystrophy (stars, left side of panel). Postoperatively, this 'flattening' is regularised (stars, right side of panel).

Figure 2 Diurnal variation of central corneal thickness (CCT) as measured by optical pachymetry before and 1 month after crosslinking. At all time points measured, postoperative CCT was distinctly lower than preoperative CCT.



Endothelial cell counts were not performed in this case. However, the cornea showed no clinical signs of decompensation at 3 months after treatment.

Similarly, Ehlers and Hjortdal investigated whether oedema related to endothelial decompensation would diminish after CXL. They reported a distinct reduction in CCT after CXL which took months to occur.⁵ Re-treatments became necessary, probably because Ehlers and Hjortdal crosslinked a swollen cornea, whereas in our approach, the cornea was dehydrated with glycerol 70% solution, thus thinned prior to treatment.

Wollensak *et al* recently reported the use of CXL in patients with bullous keratopathy. In contrast to our modification of the CXL treatment protocol, they used glucose 40%, and they preoperatively dehydrated the cornea for 1 day instead of 30 min.⁶ Whereas the dehydrating properties of glucose solution and glycerol solution are virtually identical, we cannot determine whether corneal dehydration at 1 day prior to CXL is more beneficial than our approach. However, we believe that it is more feasible clinically to perform dehydration immediately before the CXL procedure.

Patients with early Fuchs dystrophy and disturbing diurnal visual fluctuations represent a novel application for CXL. Although CXL may not prevent the outcome of the dystrophy, it may increase the patients' visual comfort until keratoplasty becomes necessary.

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Corneal aberration integrity after microincision cataract surgery: prerequisite condition for prediction of total ocular aberrations

Microincision cataract surgery (MICS) has been shown to induce less astigmatism.¹ We compared the changes in corneal shape in each patient with an intraindividual comparison of each Zernike corneal aberrations and studied the correlation between pre- and postoperative aberrometric measurements, hoping to evaluate corneal integrity after MICS.

METHODS

This prospective clinical study included 29 consecutive eyes with 1.8 mm MICS (same surgeon, PJP). Exclusion criteria were a previous ocular surgery, central endothelial cell count less than 1800 cells/mm², ocular surface pathology, glaucoma or topical treatment. Two limbal incisions of 1.8 mm (at the 10.30 o'clock position) and 1 mm (at 2 o'clock) were created with a steel blade. A 5 mm continuous curvilinear capsulorhexis was done, and the nucleus was removed with a 0.95 mm 30° angled tip, using a continuous ultrasound setting (Stellaris, Bausch and

Lomb), without any posterior capsule rupture. All IOLs (AcrySmart 36A) were inserted in the capsular bag with the injector system. No suture was used to close the incision in any case. The main outcome measures were anterior corneal surgical induced aberrations. Corneal topography was performed pre- and 6 months postoperatively by an independent physician using an Atlas 9000 corneal topography system (Carl Zeiss Meditec, Jena, Germany) to calculate anterior corneal aberrations for a 6 mm pupil diameter. All continuous variables were compared using the Wilcoxon test. Differences with a p value less than 0.05 were considered statistically significant (StatView, SAS Institute).

RESULTS

No statistically significant differences between pre- and postoperative measurements were found in mean corneal astigmatisms (Z_2^{-2} , Z_2^2 , Z_4^{-2} and Z_4^2) and in mean levels of all Zernike aberrations except for trefoil Z_3^{-3} mean value (table 1). We also compared the individual correlation between pre- and postoperative measurements for each eye and each Zernike term in order to evaluate the influence of each incision on surgery-related change in corneal aberrations postoperatively (table 1). Corneal astigmatism terms (Z_2^{-2} , Z_2^2 , Z_4^{-2} and Z_4^2), defocus term (Z_2^0), coma terms (Z_3^{-1} , Z_3^1) and, above all, corneal spherical aberration had a strong correlation between pre- and postoperative measurements (figure 1).

DISCUSSION

A strong stability of the corneal wavefront aberrations after MICS was noted. All postoperative second-, third- and fourth-order corneal aberrations are individually strongly correlated with preoperative measurements except for small values of tetrafoil aberrations. Only the trefoil Z_3^{-3} mean value was significantly greater in the postoperative measurement. In a comparative study of postoperative corneal aberrations, Yao *et al* found no statistical differences in mean levels of total coma, total trefoil and spherical aberration.⁵ In the MICS group, there were changes in trefoil and tetrafoil, with smaller magnitudes than in the SICS group.³ Compared with SICS, MICS could reduce



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